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ORIGINAL ARTICLE

Percutaneous Iliosacral Screw Technique in Isolated Posterior Pelvic Ring Disruption

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ABSTRACT

Background: The main aim of this study is evaluating the patients functional and the radiological outcomes after receiving iliosacral screws for their unstable posterior ring injuries in the pelvis. **Methods**: Thirty participants with posterior pelvic ring disruption were included in this prospective study. All patients are assessed by plain radiographs and CT. **Results**: Satisfactory rate of the surgical technique showing that 73.3% were satisfied and 26.7% were unsatisfied. The overall Majeed score shows that 76.7% of the study patients had Satisfactory score and 23.3% had unsatisfactory score. As regarding the X-ray evaluation 16.7% of the study population were Excellent , 70% of the study population were good and only 13.3 % were fair. As regarding complications, 5% had neurological damage and 5% had Hematoma and 2% had Soft tissue infection. **Conclusion**: Our study conclude that Percutaneous sacroiliac fixation has a good result in fixation of the posterior pelvic ring disruption.

Keywords: Iliosacral screw, Pelvic ring, Disruption.

INTRODUCTION

Skeletal fractures consist of 3% of injuries to the pelvis [1] and roughly 40% are unstable due to rupture of the posterior ring. Significant morbidity, such as persistent discomfort, impairment of the bowels and bladder, sexual dysfunction, and inability to resume work, is linked to sacroiliac joint injuries. When compared to nonoperative treatment, surgical stabilization of unstable pelvic injuries results in better functional outcomes, early mobilization and weight bearing, lower mortality, shorter hospital stays, and better fracture prevention [2, 3].

The conventional method of surgically repairing the sacroiliac joint was open reduction and internal fixation (ORIF), which involved the use of sacral bars or posterior plating. These implants included a number of serious dangers, including large dissection, visible implants, iatrogenic nerve injury, infection, and blood loss for the already traumatized patient [4]. The advent of percutaneous fixation with sacroiliac screws has resulted in a reduction of soft tissue damage, blood loss, and operating time as compared to an open therapy [5]. Sacroiliac screws are flexible; they can be used to treat a variety of sacral fracture patterns or dislocations of the sacroiliac joint. They can be positioned in either the supine or prone position [6].

To help with screw insertion, fluoroscopy is performed (AP exit, inlet views). Sacroiliac screw misplacement can lead to iatrogenic neurovascular problems [7].

In 3-29% of instances that are documented, sacroiliac screw misplacement is commonly detected, and in 0.5–8% of such cases, it is linked to L5 nerve root injury [8].

This study's primary goal is to assess the patients' functional and radiological results following iliosacral screws for their unstable posterior ring injuries in the pelvis.

METHODS

Thirty participants with posterior pelvic ring disruption were included in this prospective study that was conducted at orthopedic Department of Zagazig University Hospitals.

All participants provided written informed permission, and the study was authorized by Zagazig University's medical ethics committee as well as the research ethical committee (IRB number 10457-12-2-2023). The university's medical ethics committee also accepted the study's approach. This study closely followed the Declaration of Helsinki

of the World Medical Association which was created to protect subjects taking part in medical research.

In this study, specific eligibility criteria were applied to the participants. Inclusion criteria comprised individuals with closed injury, isolated injury or unstable pelvic injury. Conversely, exclusion criteria were used to exclude patients with anterior pelvic ring disruption, pediatric patients or polytrumatized patients with associated other bony fractures.

A comprehensive patient history was collected for each case, covering various aspects, including demographic information such as age and sex. Furthermore, a detailed account of mechanism of injury and previous surgical procedures was documented.

Clinical Examination:

General examination: The advanced trauma life support (ATLS) criteria are followed in the evaluation of each patient: Within 12 to 24 hours of the injury, a secondary survey was initiated following the conclusion of the initial survey. A thorough examination from head to toe was carried out, together with a review of the patient's whole medical history. allergens previous medical conditions.

Evaluation of related injuries: Injury to the skeleton: Non-skeletal injuries include muscle strains, tears in the skin above the bone, and urological, rectal, and gynecological conditions, if appropriate. Vascular assessment: Analyzing the peripheral blood vessels.

Neurological examination: Ankle and big toe dorsiflexion testing, as well as a dermatomal level analysis of their sensory functions, are used to assess the affliction of the lumbosacral plexus, namely the l4-l5 nerve roots.

Radiological Evaluation: A plain radiograph is used to evaluate each patient radiologically. For the patients, AP radiographs as well as inlet and outflow views were acquired. Their primary purpose was to identify and categorize pelvic ring injuries. Additionally, the occurrence of concomitant skeletal injuries, such as acetabular fractures, was evaluated in these views.

CT scan: Every patient had a CT scan with axial, coronal, and three-dimensional views to better comprehend the pelvic lines. A CT scan is conducted after surgery to evaluate the accuracy and minimization of screw placement.

Treatment: This included the following:

A-**Initial treatment**

By enclosing the injured pelvis with a bed sheet or a pelvic binder, the area was rendered externally immobile.

Thromboembolic prophylaxis: Encouragement to continue physical activities for the ankle and toes for mechanical thromboembolic prevention is extended to all patients. Whenever possible, pneumatic leg and calf compression was applied. Patients were kept well-hydrated. Seven patients (who had concomitant injuries that delayed SIJ fixation) received low molecular weight heparin beginning the day of the injury and stopping 12 hours before to the procedure. Low molecular weight heparin was given to each patient for 15 days following surgery, starting 6–12 hours later. intravascular cannulation combined with urinary bladder catheterization.

B-**Operative treatment:**

-Every patient who participated in the trial gave their informed consent. Using an enema to prepare the colon 24 hours before to surgery. When anesthesia was induced, patients received a dosage of two grams of third-generation cephalosporin.

-Before beginning, we used a regular transparent table. The C-arm was adjusted to ensure a precise anteroposterior view, as well as the inlet and exit views required for screw placement and reduction.

-Anesthesia: Seven patients received spinal anesthesia, four had epidural anesthesia, and one patient received general anesthesia.

-Position: During surgery, every patient was in the supine position.

-Preparations: The lower abdomen is draped loosely from the distal nipple line, encompassing the affected leg.

The iliosacral screw (s) were percutaneously inserted using the procedures listed below. With its concavity beneath the operating table, The image intensifier's C-arm was positioned horizontally, parallel to the transverse plane of the patient's pelvis. Based on this perspective, the ilio-cortical density was calculated, and the guide wire's entry location was below this mark.

The location of the superficial skin for screw insertion is 2 centimeters posterior to the place where the sacrum may be seen laterally or where a line dropped from the anterior superior iliac spine and a line from the femoral shaft cross. Using a power driver, the guide wire was advanced into the iliac cortex, sacral cortex, and the Sacroiliac joint, starting from the previously identified entrance location on the lateral view. To verify that the guide

wire would follow the intended path, radiographs of the inlet and outflow were taken. The guide wire in the outlet anterior to the neural canal should not break through the anterior sacral cortex in the inlet views, but rather be above the S1 foramen. The guide wire was measured to determine the appropriate screw length. To compress the sacroiliac joint, a 7.3 mm partly threaded screw was placed and tightened with a washer. Intraoperative x-rays were used as a last resort to verify the accuracy of the reduction and the location of the screws.

C-Post-operative: Five patients were discharged 24 hours following surgery. Following follow-up by colleagues from other departments, such as the cardiothoracic and general surgery departments, seven patients were released 48 hours following surgery.

Medications: 1. Lowmolecular-weight heparin preparations (Clexane 40 IU) were administered subcutaneously as a single injection for the prevention of deep vein thrombosis (DVT), which began 12 hours after surgery and continued for at least two weeks. 2. After one week of prophylactic parenteral wide spectrum antibiotics, two weeks of oral antibiotics were administered. 3. Sufficient pain relief 4. In addition to postoperative CT, Postoperative x-rays were collected, including the entrance and outflow views and the pelvic AP view. The purpose of these postoperative radiographs was to assess the presence of misaligned screws, fixation quality, reduction, and displacement degrees.

Rehabilitation: As soon as the patients were able, they were moved out of bed. It was advised that all patients start toe touch weight bearing with crutches after six weeks, and after an additional six weeks, to partially bear weight, provided their general condition permitted. Twelve weeks after surgery, the patients began bearing their entire weight.

Radiological assessment Before the patients were released from the hospital and throughout the first postoperative week, regular post-operative AP radiographs were taken. After surgery, follow-up radiographs were performed six, twelve, and six months later. The quality of reduction and residual displacement were evaluated in the radiographs. The posterior reduction was categorized using Matta and Tornetta's system.

Clinical evaluation: The Majeed rating system was used to evaluate each patient at the conclusion of the follow-up period. The follow up period was 2 years. The examining surgeon conducted an interview with the patients, asking them a series of questions and rating their responses based on Majeed.

Statistical analysis

SPSS software was used to examine the gathered data. Categorical data was reported as a number and a percentage, and the appropriate Fisher's test or Chisquance test was used to assess it. Continuous variables were tested for normality by Kolmogrov Smirnov tests and were analyzed by suitable statistical tests of significance. $P \leq 0.05$ was considered significant.

RESULTS

This prospective cohort interventional study was conducted at Orthopedics department, Zagazig University Hospitals, Zagazig, Egypt on 30 patients with mean age 38 years .We found 55% of them males .83.3% of the study population were workers and 16.7% of them were non workers. As regards mechanism of injury, road accidents were the most common mechanism of injury (87%) then falling from height (13%) (Table 1).

As regards operative data, about 30% of study group had 35-40 minutes operative time and 30% of them 40-45 minutes, 25% study group had 30-35 minutes operative time and 15% study group had 45-50 minutes operative time.The Mean (SD) of lag days (time from injury to surgery) was 3.5(1.2) (Table 2).

Satisfactory rate of surgical technique showing that 73.3% were satisfied and 26.7% were unsatisfied. Satisfactory rate of functional outcome reveals that 73.3% were satisfied and 26.7 were not satisfied. The overall Majeed score shows that 76.7% of the study patients had Satisfactory score and 23.3% had Unsatisfactory score .The number of satisfied patients after the procedure showed statistically significant more than unsatisfied patients. As regarding the Majeed pelvic grade,26.7% of the study population were Excellent , 56.6% of the study population were good and only 16.7 % were fair (table 3,4).

On follow up, more than half of study group had followed up till 24 weeks (52%) and 40% of them had followed up till 28 weeks. As regarding the X-ray evaluation 16.7% of the study population were Excellent , 70% of the study population were good and only 13.3 % were fair. As regarding complications, 5% had Neurological damage and 5% had Hematoma and 2% had Soft tissue infection (Table 5).

There is a direct relation between radiological and clinical evaluation; 16.7 % of fair results in

radiological examination had unsatisfactory in Majeed scoring system ,70% had good radiological evaluation (table 6).

Patients' ages and functional outcomes have a negative connection, meaning that younger patients had better outcomes than older ones. Additionally, we discovered a direct link between improved results and male sex (table 7).

Table 1: Baseline data among the studied group.

Variables	Study population	N=30
Age/years	**Mean**	**SD**
	38	16
Sex	**Number**	**Percentage**
Male	17	55%
Female	13	45%
Total	**30**	**100%**
Employment status	**Number**	**Percentage**
Working	25	83.3%
Not working	5	16.7%
Total	**30**	**100%**
Mechanism of injury	**Number**	**Percentage**
Road traffic	26	87%
Fall from height	4	13%
Total	**30**	**100%**

Table 2: Operation time and Intraoperative bleeding

Variables	Study population	N=30
Operation time/minutes	**Number**	**Percentage**
30-35 minutes	8	25%
35-40 minutes	9	30%
40-45 minutes	9	30%
45-50 minutes	4	15%
Total	**30**	**100%**
Mean (SD)	38(15)	
Time from injury to surgery (lag days)	**Number**	**Percentage**
1-3	21	92%
3-5	8	5%
6-7	1	3%
Total	**30**	**100%**
Mean (SD)	**3.5(1.2)**	
Intraoperative bleeding/ml	**Number**	**Percentage**
Up to 200 ml	12	40%
Up to 250 ml	12	40%
Up to 300 ml	6	20%
Total	**30**	**100%**

Table 3: Satisfaction rates among the studied group.

Satisfactory	Satisfied	Not Satisfied	p
Satisfactory rate of surgical technique	26 (86.7%)	4 (13.3%)	<0.01
Satisfactory rate of functional outcome	22 (73.3%)	8 (26.7%)	<0.01
Majeed score	**23(76.7%)**	7(23.3%)	<0.01

Table 4: Majeed pelvic grade among the studied group.

Majeed pelvic grade	
Grade	**Total Cases (n/percentage)**
Excellent	7 (26.7%)
Good	18 (56.6%)
Fair	5(16.7 %)

Table 5: Follow up, X-ray evaluation and complication among the studied group.

Follow up/weeks	Number	Percentage
24 weeks	15	52%
28 weeks	12	40%
32 weeks	2	5%
Lost follow up	1	3%
Total	**30**	**100%**
X-ray evaluation	**Number**	**Percentage**
Excellent	5	(16.7%)
Good	21	(70%)
Fair	4	(13.3 %)
Total	30	100%
Complication	**Number**	**Percentage**
Neurological damage	2	5%
Hematoma	5	12%
Soft tissue infection	1	2%
None	23	81%
Total	30	100%

Table 6: Relation between radiological results and clinical results among the studied group.

			Majeed		Total	X2	P
			Satisfactory	Unsatisfactory			
X-ray evaluation	Fair	N	0	5	5		
		%	0.0%	71.4%	16.7%		
	Good	N	21	2	21	9.33	0.009*
		%	91.3%	28.6%	70%		
	Excellent	N	2	0	4		
		%	8.7%	0.0%	13.3%		
Total		N	23	7	30		
		%	100.0%	100.0%	100.0%		

Table 7: Correlation of demographic data with functional outcome among the studied group.

Parameter	Standard error	OR (95% CI)	*P* value
Age	0.082	0.664 (0.596–0.768)	0.0001
Sex(males)	0.49	3.023 (1.029–8/88)	0.044

DISCUSSION

In the current study we found that satisfactory rate of surgical technique showing that 73.3% were satisfied and 26.7% were unsatisfied. Satisfactory rate of functional outcome reveals that 73.3% were satisfied and 26.7 were not satisfied. The overall Majeed score shows that 76.7% of the study patients had Satisfactory score and 23.3% had Unsatisfactory score .The number of satisfied patients after the procedure showed statistically significant more than unsatisfied patients.

As regarding the Majeed pelvic grade,25% of the study population were Excellent, 50% of the study population were good and only 25 % were fair.

Patients of **El-badawy et al. [9]** at the most recent follow-up appointment, the study participants underwent a clinical assessment based on the Majeed score. Nine patients (75%) had final overall results deemed satisfactory; three patients (25%) had exceptional, six patients (50%) had good, and three patients (25%) had inadequate fair outcomes.

The clinical and radiological outcomes of this investigation are comparable to those of other investigations employing the same methodology. In their study, **Schweitzer et al. [10]** found that 97.18% of patients had good radiological outcomes and only 2.81% had unsatisfactory results. Additionally, with a low incidence of complications, 87,3% of patients had excellent clinical results, whereas 7.14 percent had unsatisfactory results. There was no unfavorable radiological result for **Lindahl et al. [11].** 65.34% of respondents had excellent outcomes, 24.75% had acceptable results, and 9.9% had fair results. Similar clinical outcomes were seen to the study's findings. Only 0.9% of patients experienced subpar clinical outcomes, compared to 83.16% who had satisfactory results and 15.84% who had fair results. In their study, **Abhishek et al. [12]** reported that 51.22% of cases had outstanding clinical outcomes, 31.7% had good outcomes, and 9.7% of cases had unsatisfactory results, such as fair or bad. The low incidence of problems in these data is similar to that of our study.

Zhang et al. [13] revealed that the rate of satisfactory functional outcome was 84.21% (32/38) in group A and 87.50% (28/32) in group B (P =.961). The rate of satisfactory reduction quality was 86.84% (33/38) in group A (sacroiliac screw) and 78.13% (25/32) in group B (anterior plating) (P =.335).

The most used assessment system for SIJ injuries is the Majeed functional score and pelvic grade score. The majority of patients (82.92%) in the **Abhishek et al. [12]** study fell into the excellent or good group. This is consistent with findings from previous studies on similar sorts of injuries by **Papakostidis et al. [14], Chen et al. [15], and Ryšavý et al. [16].** Strict adherence to the inclusion criterion is to blame for this..

In the event that the joint reduction was not suitable, we had a very low threshold for calling off the process and choosing open reduction. While the bulk of SIJ-related behaviors are covered by the Majeed functional score, it is deficient in evaluating three acts that are thought to be crucial in many poor and underdeveloped nations: squatting, sitting cross-legged, and forward bending (in the prayer/namaz position). These are the exact activities that were significant for our patient population, which consisted primarily of manual laborers from lower socioeconomic backgrounds. Even while the Majeed scoring method does not directly account for these activities, the study's end result, as previously stated, is consistent with other research.

We found that more than half of study group had followed up till 24 weeks (52%) and 40% of them had followed up till 28 weeks. As regarding the X-ray evaluation 16.7% of the study population were Excellent, 70% of the study population were good and only 13.3 % were fair .

El-badawy et al. [9] revealed that the follow-up period had a mean of nine months and varied from six to twelve months.

Radiological results of **El-badawy et al. [9]** revealed that three patients had residual displacement of less than 5 mm, making them good. It was good to have residual displacement of 5–10 mm in six cases. Three patients had residuals that ranged from 11 to 20 mm, which was fair.

Schweitzer et al. [10] Only 2.81% of patients in their research had a poor radiological outcome,

whereas 97.18% of patients had a satisfactory radiological outcome. Additionally, with a low incidence of complications, 87,3% of patients had excellent clinical results, whereas 7.14 percent had unsatisfactory results. However, the results of **Lindahl et al. [11]** radiography were not dismal. 65.34% of respondents had excellent outcomes, 24.75% had acceptable results, and 9.9% had fair results. Similar clinical outcomes were seen to the study's findings. Only 0.9% of patients experienced subpar clinical outcomes, compared to 83.16% who had satisfactory results and 15.84% who had fair results.

Also, **Abhishek et al. [12]** reported in their study that 51.22% of patients had a great clinical outcome, 31.7% had a good outcome, and 9.7% of cases had fair results or 7.31% had bad results. The low incidence of problems in these data is similar to that of our study.

In the current study, we found that 55% of them males .83.3% of the study population were workers and 16.7% of them were non workers.

El-badawy et al. [9] Twelve patients with SIJ disturbances had surgery at Zagazig University Hospital; seven of the patients were male and five were female, ranging in age from 19 to 59.

One established method for treating the unstable posterior pelvic lesion is iliac sacral screw fixation **[17]. Kellam et al.** reported the first open screw fixation of a sacroiliac dislocation in 1934 **[18].** The open technique has a high rate of complications related to poor wound healing; in one series, the incidence was as high as 25% **[19].** The percutaneous procedures prevented these issues. Matta pioneered the use of inlet and outlet fluoroscopic projections to facilitate percutaneous screw insertion in a prone position **[20].**

Road accidents were the most frequent mechanism of injury (87%) followed by falls from heights (13%)

El-badawy et al. [9] showed that the most common cause of injury was a traffic collision (58.3% of cases), followed by a fall from a height (41.7%). Six patients had injuries to their right side, five patients to their left, and one patient suffered injuries to both sides.

El-Mannawy et al. [21] reported that the mechanisms of injury in their patients were motor car accidents in nine (90%) patients and falling from height in one (10%) patient. In the study of **Dalal et al. [22],** motor car accidents were the cause of injury in 58% of patients, and in 57% of patients in the series of **CRYER et al. [23]** and 54% of patients in the series of **Goldstein et al. [24].**

Our study showed that about 30% of study group had 35-40 minutes operative time and 30% of them 40-45 minutes, 25% study group had 30-35 minutes operative time and 15% study group had 45-50 minutes operative time.The Mean (SD) of lag days (time from injury to surgery) was 3.5(1.2) .

El-badawy et al. [9] revealed that 2 patients (16.7%) had B2 injuries and 5 patients (41.7%) had B1 injuries based on the tile classification. C2 comprised 5 patients (41.7%). Two patients (16.7%) met the Young and Burgess classification criteria, while five patients (42.7%) did. Were APC2, two patients (16.7%) had vertical shear, and three patients (25%) had a mixed cause. The follow-up period had a mean of nine months and varied from six to twelve months.

Similar to our findings, All patients in **El-badawy et al. [9]**The duration of the study was 1 day to 7 days, with a mean of 3.83 days and a standard deviation of 2.17 days. The operation took, on average, 37 minutes, with a minimum of 30 minutes and a maximum of 50 minutes. After the follow-up period, the patients underwent both clinical and radiological assessments.

Zhang et al. [13] reported that the average blood loss was 287.11 ml in unilateral sacroiliac screw compared to anterior plating 426.56 ml.

Our current study illustrated that 5% had Neurological damage and 5% had Hematoma and 2% had Soft tissue infection.

El-badawy et al. [9] discovered that no preoperative or intraoperative complications had been found in any of the cases under study. Following surgery, all problems were noted. A superficial infection that improved with drainage, repeated dressing changes, and medications was described by 25% of patients. Medication for pain and inflammation alleviated recurring posterior pelvic pain in only one patient.

Although open reduction and fixation of the sacroiliac joint (SIJ) allows precise reduction and joint visibility, the percutaneous procedure is a more suitable technique for sacroiliac joint fixation due to the related problems as reported in comparative studies. **El-Mannawy et al. [21]** observed foot drop, pelvic tilt, and deep tissue infection during their anterior SIJ stabilization trial. **Mardanpour et al. [25]** documented a number of side effects from the open approach of SIJ fixation, such as urinary tract infections, pulmonary embolism, damage to the lateral cutaneous nerve of

the thigh, and deep and superficial infections. Two patients with stable fixation and one patient with plate fixation experienced loss of reduction, according to **SIMPSON et al.'s [26]** study on open reduction and fixation of SIJ using staples or plates. In their investigation of spino-pelvic fixation in cases of sacroiliac joint injuries, **Sobhan et al. [27]** observed that while 78% of cases had satisfactory clinical outcomes and 92.8% had excellent reduction, 7.1% of cases had confirmed implant failure and 21.4% had wound infection.

The most common percutaneous technique complications include superficial infections, nerve root injuries, and screw mispositioning. The most dangerous consequence is damage to the lumbosacral roots as a result of screw misplacement; the likelihood of an incomplete reduction enhanced this risk. Numerous technologies, such as CT guided and computer assisted navigation guided techniques, have been employed to prevent screw misplacement; however, due to their limitations, fluoroscopy is typically required in these circumstances. **[28]**.

Due to the injury pattern's rarity, the study's limited sample size is its main drawback. A larger study population, ideally incorporating several sites, will be necessary for the validation of the Majeed score in our patient sample. In order to evaluate the effectiveness of the score and the results for percutaneous screw fixation in cases of unstable SIJ injuries, a comparison with alternative treatment modalities was also conducted.

The limitations of our investigation were as follows: limited sample size, one center, and a brief two-year follow-up period characterize the study.

Conflict of Interest: None

Financial Disclosures: None

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