Open reduction internal fixation versus percutaneous iliosacral screw fixation for unstable posterior pelvic ring disruptions

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ABSTRACT

Background: Surgical stabilization of posterior pelvic ring fractures can be achieved by either open or closed methods. They all provide a comparable biomechanical stability. The aim of the present study is to compare the clinical results of both techniques for treating posterior pelvic ring injuries.

Material and methods: Seventy patients operated for unstable posterior pelvic ring disruptions were retrospectively reviewed. We compared 35 patients treated by open reduction internal fixation (ORIF group) versus 35 patients stabilized by using closed reduction and percutaneous iliosacral screw fixation (CRIF group) under fluoroscopic guidance.

Results: According to pelvic outcome scoring system of Pohlemann et al., 28 patients out of the ORIF group obtained good or excellent results (20 excellent and 8 good), five fair and two poor. In the CRIF group, 30 patients obtained good or excellent results (25 excellent and 5 good), four fair and one poor (P = 0.64). The average intraoperative blood loss in the ORIF group was 500 cc with average blood transfusion of 2 units (1000 cc) compared to blood loss 150 cc in the CRIF group, with average blood transfusion of 1 unit (500 cc) (P = 0.002). No intraoperative complications were reported in the ORIF group while operative guide wires were broken in two cases in the CRIF group (P = 0.16). There were no neurological complications observed in the ORIF group, but one radiculopathy (L5 root palsy) occurred in the CRIF group (P = 0.317). In the ORIF group, three patients had superficial wound infection and one patient had deep infection while in the CRIF group, we noted only one case of deep infection (P = 0.083).

Conclusion: No difference was noticed between ORIF and CRIF. The technical decision is variable according to the type of fracture, fracture types, patient general condition, skin condition, presence of ipsilateral fractures of the acetabulum and feasibility of the closed reduction. More studies are needed to identify prognostic factors related to quality of the reduction. We need for creation of decisional algorithm for ORIF versus CRIF.

Level of evidence: Level 4.

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1. Introduction

Whether posterior pelvic ring injuries are best treated using open reduction and internal fixation (ORIF) or closed reduction and percutaneous iliosacral screw (CRIF) remains a controversial topic [1–11]. Papakostidis et al. [10], in a systematic review of the English literature over the last 30 years, concluded that current literature is insufficient to provide “clear” evidence for clinical decision making in regard to the optimal treatment of unstable pelvic ring injuries. The purpose of the present study is to evaluate and compare the outcomes of posterior pelvic ring injuries managed by either ORIF or CRIF for unstable posterior pelvic ring disruptions.

2. Material and methods

Between June 2005 and December 2012, the present retrospective study was conducted. We selected 70 patients with pelvic fractures who met the inclusion criteria for treating posterior pelvic ring disruptions that were treated at the trauma unit of our university hospitals. The inclusion criteria were patients who had operations for fixation of the posterior pelvic ring disruptions either by open reduction and internal fixation (ORIF) or closed reduction and percutaneous iliosacral screw fixation (CRIF). We also selected the age between 18 to 50 years. Other variables as patients with open fracture pelvis, conservative treatment and patients with...
either above or below the age limit were excluded. The limitations of open technique were patients with infection, extensive soft tissue damage or Morel-Lavallee lesions and for the percutaneous technique were the patients with crescent fractures (Day type I and type II) and abnormal sacral anatomy or sacral dismorphism. The patients were classified into two groups: the ORIF group in which the 35 patients were stabilized by using open reduction and internal fixation of the sacroiliac joint, while in the CRIF group the other 35 patients were stabilized by using closed reduction and percutaneous iliosacral screw fixation inserted under fluoroscopic guidance. After initial emergency room resuscitation, an evaluation through radiographic evaluations including anteroposterior, inlet and outlet incidence was conducted. A CT-scan of the pelvis was performed in each case with 3-mm sections through the sacroiliac joint. None of the patients required temporary stabilization of the pelvis for hemodynamic instability. All pelvic disruptions were classified according to the Tile system [2]. When mandatory we used Day classification [11] for crescent fracture-dislocation of the sacroiliac joint and Roy-Camille classification [12] for sacral fractures. Repartition of the different types in the both groups, regarding each classification, is summarized in Fig. 1. Characteristics of the both group are summarized in Table 1.

2.1. The ORIF group

They were 28 males and 7 females. Anterior pelvic injuries in the 35 patients were variable; they were as follows: 27 patients had symphysis pelvic disruptions and in 8 patients the superior and inferior pubic ramie were fractured.

2.2. The CRIF group

They were 25 males and 10 females. Anterior pelvic injuries in the 35 patients were variable and were as follows: in 25 patients there were symphysis pelvic disruptions and in the other 10 patients the superior and inferior pubic ramie were fractured.

2.3. Methods and techniques of fixation

General anesthesia was used in all patients. Methods of fixation are summarized in Table 2.

![Fig. 1. Pelvic disruptions were classified according to the Tile system classification [2] and for more precision, Day classification [11] was used for crescent fracture-dislocation of the sacroiliac joint and Roy-Camille classification [12] was used for sacral fractures.]

Table 1: Fracture classification according to Tile [2], Day [11], Roy-Camille [12] classifications, which side was affected, associated extra pelvic skeletal injuries, associated head injuries and associated soft tissue injuries in the ORIF and the CRIF groups.

<table>
<thead>
<tr>
<th>Classifications</th>
<th>ORIF group</th>
<th>CRIF group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tile type B1</td>
<td>10 (28.6%)</td>
<td>13 (37.1%)</td>
</tr>
<tr>
<td>Tile type B2</td>
<td>12 (34.3%)</td>
<td>8 (22.9%)</td>
</tr>
<tr>
<td>Tile type B3</td>
<td>4 (11.4%)</td>
<td>5 (14.3%)</td>
</tr>
<tr>
<td>Tile type C1</td>
<td>6 (17.1%)</td>
<td>5 (14.3%)</td>
</tr>
<tr>
<td>Tile type C2</td>
<td>3 (8.6%)</td>
<td>4 (11.4%)</td>
</tr>
<tr>
<td>Day type I</td>
<td>8 (22.9%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Day type II</td>
<td>18 (51.4%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Day type III</td>
<td>0 (0%)</td>
<td>25 (71.4%)</td>
</tr>
<tr>
<td>Roy-Camille type I</td>
<td>0 (0%)</td>
<td>2 (5.7%)</td>
</tr>
</tbody>
</table>

Affected side
- Bilaterally affected
- Right side
- Left side

Associated extra pelvic injuries
- Humeral fractures
- Ipsilateral femoral fractures
- Calcaneal fractures
- Both bone leg fractures

Associated head injuries
- Subdural hematoma
- Post-concussion
- Fissured skull
- Associated soft tissue injuries
- Splenic tears
- Bladder injuries
- Vaginal laceration
- Morel-Lavallee lesions

N.B.: In both groups, the 26 patients who were classified as Tile type B1–B3 were included within the Day classification for more precision.

2.4. Postoperative assessment

Patients were reviewed both clinically and radiologically by means of Pelvic outcome scoring system for radiological and clinical results that was calculated for every patient depending on the criteria as described by Pohlemann et al. [13] (Table 3). Radiological criteria were assessed by plain AP, inlet and outlet projections, included the quality of fracture reduction and evidence of union. During follow-up, serial radiographs were taken each month until 3 months and afterwards every 2 months until healing was observed and at the last follow-up. In cases of persistent pain, additional pelvic CT-scans were obtained in nine patients to rule out sacroiliac non-union, sacroiliac osteoarthritis or any doubt about fracture union. The measurements were done by independent observers and the displacement was measured with pixel calibration.

2.5. Ethical approval

All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1975 Helsinki declaration as revised in 2000. Informed consent was obtained from all individual participants included in the study.

2.6. Statistical analysis

SPSS program version 16.0 for windows (Chicago, Illinois, USA, 2007), in which Wilcoxon signed-rank test was used for statistical analysis of the results and P < 0.05 was considered to be significant.
Table 2
Methods of stabilization of the anterior pelvic ring injuries, open reduction and internal fixation by plate and screws, using anterior exposures (ORIF), supra acetabular external fixator (SAEF) and methods of stabilization of the posterior pelvis injuries in both ORIF and CRIF groups.

<table>
<thead>
<tr>
<th>Injuries stabilization</th>
<th>ORIF group</th>
<th>CRIF group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior pelvic ring injuries stabilization</td>
<td>(32) (91.4%)</td>
<td>(33) (94.3%)</td>
</tr>
<tr>
<td>SAEF</td>
<td>(3) (8.6%)</td>
<td>(2) (5.7%)</td>
</tr>
<tr>
<td>Posterior pelvic ring injuries</td>
<td>18 (51.4%)</td>
<td>35 (100%)</td>
</tr>
<tr>
<td>Injuries stabilization</td>
<td>17 (48.6%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3
The pelvic outcome score (Pohlemann et al. [13]).

<table>
<thead>
<tr>
<th>Points</th>
<th>Radiological result (maximal 3 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Anatomical posterior healing, anterior displacement pubic symphysis &lt; 5 mm and/or maximal displacement pubic rami &lt; 10 mm</td>
</tr>
<tr>
<td>2</td>
<td>Maximal posterior displacement 5 mm and/or maximal anterior displacement, pubic symphysis 6–10 mm, and/or pubic rami 10–15 mm</td>
</tr>
<tr>
<td>1</td>
<td>Posterior displacement &gt; 5 mm and/or maximal anterior displacement pubic symphysis &gt; 10 mm and/or maximal displacement pubic rami &gt; 15 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Points</th>
<th>Clinical result (maximal 4 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>No pain, no neurological deficiencies, no urological deficiencies, no functional deficiencies</td>
</tr>
<tr>
<td>3</td>
<td>Pain after extensive exercise, no analgesics, slight functional deficiency (occasional limping), slight sensory deficiencies, subjectively not disturbing</td>
</tr>
<tr>
<td>2</td>
<td>Always pain after exercise, analgesics, occasionally notable functional deficiency (limping and cane), motor nerve deficiencies with no functional handicaps and/or sensory deficiencies without loss of the protective sensibility, disturbances in micturation without residual urine and/or erectile dysfunction or sexual dysfunction, subjectively not disturbing</td>
</tr>
<tr>
<td>1</td>
<td>Permanent pain at rest, frequent use of analgesics, regular use of canes, crutches, wheelchair; disabling motor nerve deficiencies (e.g. foot drop) and/or sensory deficiencies with loss of the protective sensibility, deficiencies in micturation with residual urine and/or subjectively disturbing erectile dysfunction or sexual dysfunction. Bowel incontinence</td>
</tr>
</tbody>
</table>

While the comparative statistical analysis of Pohlemann et al. [13] score for functional outcome of pelvic fractures was carried out using SPSS version 2.2 for windows in which Chi-square ($\chi^2$) test was used for statistical analysis and $P < 0.05$ was considered to be significant.

3. Results

The main follow-up was 4 years in both groups (range from 3–6 years). Pelvic outcome scoring system was calculated for every patient depending on the criteria as described by Pohlemann et al. [13] (Table 3) where radiological results (maximum 3 points), and the clinical results (maximum 4 points), and the calculated score rated as excellent for 7 points, good for 6 points, fair for 5–4, and poor for 3–2 points. In the ORIF group, 28 patients obtained good or excellent results (20 excellent and 8 good), five fair and two poor. In the CRIF group, 30 patients obtained good or excellent results (25 excellent and 5 good), four fair and one poor. The $P$-value = 0.64 = non-significant (Fig. 2 and Table 4). The average intraoperative blood loss in the ORIF group was 500 cc with average blood transfusion of two units (1000 cc) compared to blood loss 150 cc in the CRIF group, with average blood transfusion of one unit (500 cc) ($P = 0.002$). No intraoperative complications were reported in the ORIF group while operative guide wires were broken in two cases in the CRIF group ($P = 0.16$). There were no neurological complications observed in the ORIF group, but one radiculopathy (L5 root palsy) occurred in the CRIF group ($P = 0.317$). In the ORIF group, three patients had superficial wound infection and one patient had deep infection while in the CRIF group, we noted only one case of deep infection ($P = 0.083$). In the present series, no significant relation could be detected as regarding advantages or complication after separate analysis of either anterior or posterior approaches or as regarding the late referral.

4. Discussion

Although there are many techniques for both open and closed reductions, the main difficulty remains in achieving anatomic restoration of the pelvis [6,9,14–17]. Lindsay et al. [18] in their recent study compared closed reduction and percutaneous posterior pelvic disruption fixation (CRPP) versus open reduction and internal fixation (ORIF) of type 3 posterior ring injuries. They reviewed 113 consecutive cases of unilateral unstable posterior ring injuries treated by two physicians in two different centers with iliosacral (IS) screws. They concluded that CRPP done is as effective as the gold standard of prone ORIF in obtaining an accurate reduction of type 3 posterior pelvic ring injuries. In the present study, the imperfect reduction complication was non-significant in the percutaneous closed technique (CRIF) group compared to the open technique (ORIF) group. Ruatti et al. [19] in their study concluded that the percutaneous iliosacral screw fixation helps to minimize the complications related to open reduction technique. The advantages include the absence of decompression of the intra-pelvic haematoma and decreased intra- and postoperative bleeding and also eliminate morbidity related to the posterior approach [19–23]. In our series, we had two cases of sacral fractures; these cases were further manipulated using closed technique by distal femoral traction or percutaneous Schanz screw in the greater trochanter. We agree with Ruatti et al. [19] in that good quality percutaneous reduction is usually sufficient to achieve decompression of the sacral roots [19–23]. Day et al. [11] suggested classification offers guidance on the choice of surgical approach. In spite of Day et al. proposed this classification algorithm but within the same series, the decision was changed according to the timing, skin condition, the presence or absence of pin tract infection or ipsilateral acetabular fracture [24–26]. According to Pohlemann et al. [13], no significant difference was noticed between both groups with $P$-value = 0.64. These favorable results may be attributed to the fact that high numbers of our patients in the present series were of type B injury [25–27]. This is supported by the findings of Pohlemann et al. where the pelvic outcome score of their patients resulted in rate of 3% unsatisfactory results after B- and 23% after C-type fractures. Fracture pattern and timing of the surgery are considered as one of the important factors in the decision making of surgical procedures. Although there is no relationship as regarding the late referral could be founded in our series due to that, all the cases of the present study were done within 10 days, the delay of timing for surgery would make the extensive callus
or fibrosis to change the surgical plan from closed to open to be mandatory or even the decision to postpone the surgery for the favor of non-operative management to be obligatory [11,28–30]. Open reduction and internal fixation of the fractured and dislocated sacroiliac joint can be performed via either an anterior or posterior approach [31,32]. In the present series, no significant relation could be detected as regarding advantages or complication after separate analysis of either anterior or posterior approaches. In the present study, the authors face the common problems and limitations faced by the authors in the previous literatures including the analysis of surgical procedures that is hampered by the use of small subject groups, infrequent use of a control group, unmatched selection of patients of varying ages and a varying severity of the injury process.

5. In summary and conclusion

No significant differences were noticed in the Pohlemann et al. outcome score of pelvic fractures between both groups with these different techniques. The technical decision is variable according to time of surgery or referral, fracture types, patient general condition, skin condition, presence of ipsilateral fractures of the acetabulum and feasibility of the closed reduction. More studies are needed to identify prognostic factors related to quality of the reduction. We need for creation of decisional algorithm for ORIF versus CRIF.

Disclosure of interest

The authors declare that they have no competing interest.

References


Fig. 2. Statistical comparative analysis of Pohlemann et al. [13] score for functional outcome of pelvic fractures.

Table 4

<table>
<thead>
<tr>
<th>Result</th>
<th>ORIF group</th>
<th>CRIF group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Excellent</td>
<td>20</td>
<td>57.14</td>
</tr>
<tr>
<td>Good</td>
<td>8</td>
<td>22.86</td>
</tr>
<tr>
<td>Fair</td>
<td>5</td>
<td>14.29</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>5.71</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
</tbody>
</table>

NS: non-significant (P ≥ 0.05).