Percutaneous Limited Internal Fixation Combined With External Fixation to Treat Open Pelvic Fractures Concomitant With Perineal Lacerations

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Abstract

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External fixation combined with colostomy is a traditional management of the pelvic fractures associated with perineal lacerations. However, malunion and dysfunction caused by malreduction and loss of reduction are common. One-stage definitive fixation without soft tissue harassment is requisite for the treatment. The purpose of this study was to assess the outcome of 1-stage definitive fixation by combining percutaneous limited internal fixation and external fixation in the treatment of pelvic fractures with perineal lacerations. Eighteen adults with high-energy unstable pelvic ring fractures associated with perineal lacerations were admitted between June 2003 and December 2010. Mean follow-up was 28 months. After wound closure and colostomy, 10 patients received external fixation and percutaneous screw fixation, and 8 patients underwent external fixation. Demographics, wound and fracture classification, and Injury Severity Score were comparable between the groups (P>0.05). Initial reduction quality was comparable between the groups (P=0.14), but the loss of reduction during follow-up was more significant in the external fixation group (P=0.04). Combined fixation achieved better functional results than external fixation (P=0.02). There were 2 cases of superficial wound infection in each group (P=1.0). By combining debridement, wound closure, colostomy, percutaneous limited internal fixation, and external fixation, we improved pelvic fracture recovery while reducing the risk of infection. One-stage definitive fixation is a better choice than external fixation in the treatment of open pelvic fracture concomitant with perineal wound.

Figure 1: Photograph at admission showing perineal laceration from the lower abdominal wall to the sacrum.

Figure 2: Pelvis radiograph obtained at admission showing pubic symphysis separation.

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pen pelvic fracture is one of the most devastating injuries in orthopedic trauma. Pelvic fractures with perineal lacerations are known to carry a high mortality rate and significant morbidity.1,2 The traditional management of pelvic fractures with perineal lacerations includes control of hemorrhage, debridement, external fixation of the pelvis, and immediate diverting colostomy.3-5 External fixation is useful in the acute phase of resuscitation; however, it is of limited value in the definitive treatment of an unstable pelvic injury because it cannot control vertical translation and posterior diastasis.6 Incomplete reduction and loss of reduction may cause malunion and dysfunction during rehabilitation. One-stage definitive fixation without soft tissue harassment is requisite for pelvic fractures with perineal lacerations.

We recommend 1-stage treatment for pelvic fractures with perineal lacerations by combining debridement, wound closure, colostomy, percutaneous reduction, percutaneous limited internal fixation, and external fixation. We compared this 1-stage combined fixation with traditional external fixation in the treatment of pelvic fractures with perineal lacerations. Long-term radiological and functional outcomes were compared. Special attention was paid to loss of reduction, infection, late symptoms, and functional recovery.

MATERIALS AND METHODS

This study is a retrospective review of a retrospectively collected open pelvic fracture database between June 2003 and December 2010. Patients with unstable pelvic fractures (Orthopaedic Trauma Association types B and C) and wounds in Faringer Zone I were included.7-9 Patients with stable pelvic fractures and wounds in Faringer Zone II or III were excluded. Eighteen adults with high-energy unstable pelvic ring fractures associated with perineal lacerations were included. Demographics (age and sex), perineal wound description,10 fracture classification,11 Injury Severity Score (ISS),12 and associated injuries were extracted from the database. Ten patients (group 1) were treated with debridement, wound suture, colostomy, and a combination of percutaneous limited internal fixation and additional external fixation; 8 (group 2) were treated with debridement, wound closure, external fixation, and colostomy. All reduction and fixation was performed or supervised by 1 pelvic trauma surgeon (X.G.) within 8 hours after injury.

Mean time of follow-up was 28 months (range, 23-36). Functional results and final radiological results were analyzed. This study was approved by the Medical Ethical Committee of the authors’ institution.

SURGICAL TECHNIQUE

Eighteen adults with pelvic fractures with perineal lacerations were admitted in the emergency room (Figures 1, 2). After stable vital signs were achieved by aggressive resuscitation, wound packing and external fixation were applied. Computed tomography (CT) scan of the head, chest, and abdomen and skeletal radiographs were performed to exclude associated injuries. Patients with abdominal organ injuries first underwent laparotomy. Management of perineal laceration, including meticulous wound debridement, repeated irrigation, and primary wound closure, was performed. Anal sphincter and vaginal lacerations and intraperitoneal bladder disruptions were repaired promptly. Urethral injuries were treated by early realignment and delayed end-to-end repair. Patients then underwent diversion colostomy and remaining rectal washout (Figure 3).

After abdominal organ injuries and perineal wounds were repaired, initial external fixators were loosened temporarily. The pins fixed in the ilium were carefully manipulated to correct rotational and vertical displacement under C-arm fluoroscopy monitoring, then the external fixators were tightened again. In group 1, medullary pubic ramus and transiliac and iliosacral screws were inserted percutaneously in a traditional way.13,14 Pubic symphysis separation was treated with a unique technology.15 One large clamp was applied across the symphysis to reduce separation percutaneously. A Kirschner wire was drilled through the symphysis under C-arm fluoroscopy monitoring in anteroposterior and inlet views. Then the K-wire was replaced by a 7.3-mm cannulated screw. The screw thread must go beyond the contralateral cortex to prevent pulling out (Figure 4).
All patients were transferred to the intensive care unit postoperatively. Wide-spectrum antibiotic coverage was started preoperatively and continued for 12 days. The colostomy takedown and external fixator removal were performed 10 weeks later.

Outcome Evaluation
Radiographs were taken before primary treatment, after fixation, and at the final follow-up. The radiological result was graded by the maximal residual displacement in the posterior or anterior injury to the pelvic ring (excellent, 0-4 mm; good, 5-10 mm; fair, 11-20 mm; poor, >20 mm). Functional outcome was measured using the scoring system described by Majeed, which is based on the clinical findings of pain, sitting, sexual intercourse, walking, and work.

Statistical Analysis
Statistical analyses were performed using t test, Fisher’s exact test, and Wilcoxon rank-sum test. A P value of <.05 was considered significant.

RESULTS
Demographic and injury severity data were not different in the 2 groups with regard to age, sex, ISS, fracture characteristics, and wound grade (P > .05) (Table 1). Two patients in group 1 and 2 patients in group 2 had spleen or liver injuries and underwent acute laparotomy. Three patients in each group had anal/rectal rupture and underwent repair. Three patients in group 1 and 2 patients in group 2 had genitourinary injuries and underwent repair. Four patients in group 1 and 3 patients in group 2 had fractures in other areas such as the femoral neck, spine, and tibia.

The reduction procedures were comparable between the 2 groups. In group 1, three patients underwent anterior symphyseal screw fixation and 7 underwent combined fixation. The displacement remaining postoperatively was 5.6 ± 2.8 mm in group 1 and 7.9 ± 3.6 mm in group 2. Reduction quality was comparable between the 2 groups (P = .14) (Table 2). Combined fixation achieved better radiological and functional outcomes than external fixation. Average displacement at final follow-up was 6.0 ± 3.1 mm in group 1 and 15.3 ± 6.4 mm in group 2 (Figures 5, 6). Loss of reduction was more significant in the external fixation group (P = .004) (Table 3). Average functional scores were 81 ± 9 in group 1 and 66 ± 14 in group 2. Combined fixation achieved better outcomes than external fixation (P = .02) (Table 4).

No patients who were treated with fecal diversion developed complications related to either the colostomy creation or the subsequent takedown. Two patients in each group experienced infections in the perineal wounds (P = 1.0). They were regarded as superficial infections and treated.
by debridement and antibiotics. No patients developed severe infection (eg, sepsis, pelvic abscess, osteomyelitis) or rectal incontinence.

**DISCUSSION**

Open pelvic fracture comprises 2% to 4% of all pelvic fractures.2,18,19 Open pelvic fracture is usually subjected to significant kinetic energy transfers and is associated with a high mortality rate. Duchesne et al9 found that patients with pelvic fractures with perineal lacerations had significantly more complications, including sepsis, pelvic abscess, acute respiratory distress syndrome, multi-organ system failure, and death, compared with closed pelvic fractures. Treatment of pelvic fractures with perineal lacerations requires an aggressive, multidisciplinary team approach.20

The most important factors that correlate with mortality and morbidity are insufficient stability of the pelvic fracture and the presence of a perineal wound with involvement of the rectum.21 In our study, 6 cases failed in the external fixed group. These patients experienced loss of reduction, malunion, and poor outcome. When we realized the cause of failure, we adjusted our therapeutic regimen and achieved excellent outcomes.

Open perineal and urogenital wounds allow an additional route for fecal contamination. Jones et al21 found that 78% of patients with pelvic fractures with perineal lacerations developed systemic septicemia compared with 11% of those with closed fractures. Successful treatment of perineal wounds correlates closely with fecal diversion.1-4,22,23 In all of our cases, immediate colostomy and wound closure were performed after debridement, and the infection rate was low.

Definitive stabilization for open pelvic fracture is necessary according to the principles of “damage-control orthopedics.” Pelvic stabilization is the key measure to control hemorrhage.24 Furthermore, a mechanically unstable pelvis is associated with a ten-fold increased risk of infection.25 Traditionally, only external fixation techniques are used in the treatment of open pelvic fractures for fear of incision infection.26 External fixation is useful in the acute phase of resuscitation, but it is of limited value in the definitive treatment of unstable pelvic injuries.6,27,28 An external fixator deformity (eg, flexed and internally rotated hemipelvis, posterior cephalad translation, or posterior diastasis) may occur during rehabilitation.29 More than 10 mm of residual vertical displacement of the injury to the posterior pelvic ring is significantly related to poor outcome.6 In our study, loss of reduction and malunion were seen in 6 patients in group 2 and 1 patient in group 1. Internal fixation enhanced the strength of external fixation. Some surgeons prefer second-stage open reduction internal fixation (ORIF) to erect malre-

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**Table 3**

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<tr>
<th>No. of Remaining Displacement After Reduction</th>
<th>Excellent (0-4 mm)</th>
<th>Good (5-10 mm)</th>
<th>Fair (11-20 mm)</th>
<th>Poor (&gt;20 mm)</th>
<th>( p ) Value</th>
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<tr>
<td>Group 1(^a)</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>.004</td>
</tr>
<tr>
<td>Group 2(^b)</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>1</td>
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\(^a\)External fixation with percutaneous internal fixation and colostomy.  
\(^b\)External fixation with colostomy.

**Table 4**

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<th>Functional Results(^a)</th>
<th>No.</th>
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<td></td>
<td>Excellent (&gt;85)</td>
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<tr>
<td>Group 1(^b)</td>
<td>5</td>
</tr>
<tr>
<td>Group 2(^c)</td>
<td>1</td>
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\(^a\)According to Majeed.17  
\(^b\)External fixation with percutaneous internal fixation and colostomy.  
\(^c\)External fixation with colostomy.
duction and strengthen fixation. However, open wound and stoma will postpone ORIF, which must be completed within 1 week.30 Emergent ORIF after colostomy was recommended by some researchers for pelvic fractures with perineal lacerations, but it was only applicable for those without gross contamination in the fracture region.5 Percutaneous internal fixation seems to be a better choice.

Percutaneous fixation of pubic rami fractures, sacroiliac joint dislocation, and sacral fractures using C-arm fluoroscopy, CT, or navigation guidance permits adequate pelvic ring stabilization with minimal violation of the soft tissue envelope.12,15,13,14 Percutaneous limited internal fixation can make up for the weak strength of the external fixator. In cases of open-book injuries, external fixation and anterior percutaneous screw techniques should be applied simultaneously to control the rotational strength.15 As for type-C injuries, which are frequently associated with posterior structure damage, external fixation should be combined with sacroiliac joint screw fixation.31 The combined fixation prevents a second operation and encourages early ambulation. By combining debridement, wound closure, colostomy, percutaneous limited internal fixation, and external fixation, we improved the stability of the pelvis while reducing the risk of wound infection.

CONCLUSION
One-stage definitive fixation using external fixation combined with percutaneous screw fixation is better than external fixation in the treatment of open pelvic fracture concomitant with perineal wound. The limitations of our research include its retrospective nature and the inadequate number of cases to draw statistically significant conclusions. Our technique may provide a new way to treat pelvic fractures with perineal lacerations.

REFERENCES