Management of Gunshot Pelvic Fractures With Bowel Injury: Is Fracture Debridement Necessary?

Saqib Rehman, MD, Colin Slemenda, BS, Christopher Kestner, MD, and Siddharth Joglekar, MD

Background: Low-velocity pelvic gunshot injuries occur commonly in urban trauma centers, occasionally involving concomitant intestinal viscus injury leading to potential fracture site contamination. Surgical debridement of the fractures may be necessary to prevent osteomyelitis, although not routinely performed in many centers. The purpose of this study was to determine whether fracture debridement should be done to prevent osteomyelitis in these injuries.

Methods: A 5-year retrospective review of all patients older than 12 years with low-velocity gunshot pelvic fractures was performed at an urban Level I trauma center. Medical records and radiographs/computed tomographic scans were reviewed, and data regarding fracture location, concomitant intestinal viscus injury, orthopedic surgical intervention, antibiotic treatment, and bone and/or joint infection were recorded.

Results: Of a total of 103 patients identified, 19 had expired within 48 hours and were excluded, resulting in a total of 84 study subjects for review. Fifty of 84 patients (59%) had a perforated viscus with 31 large bowel injuries and 30 small bowel injuries. Eighteen patients (21%) had intra-articular fractures, 15 of which involved the hip joint. Orthopedic surgical fracture debridement was done only in intra-articular fractures with retained bullet fragments (seven cases). Deep infection occurred in one patient with a missile injury to the hip joint with concomitant intestinal spillage. Immediate joint debridement was performed in this case, but successful missile fragment removal was not achieved until the second debridement after 48 hours. No infections occurred in any extra-articular fractures, regardless of the presence of intestinal spillage.

Conclusions: Extra-articular gunshot pelvic fractures do not require formal orthopedic fracture debridement even in cases with concomitant intestinal viscus injury. However, debridement with bullet removal should be done in cases with intra-articular involvement, particularly if there are retained bullet fragments in the joint, to prevent deep infection.

Key Words: Gunshot fracture, Pelvic fracture, Infection, Firearm.

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Low-velocity gunshot injuries from civilian firearms continue to be a problem in inner city America. As a result, orthopedic surgeons are continually confronted with complex fractures of the extremities and occasionally fractures of the pelvis and spine from firearms. Although irrigation and debridement are frequently indicated with missile injuries with intra-articular penetration, this is not routinely done for extra-articular injuries. Management of low-velocity extra-articular gunshot injuries to the extremities is frequently done without formal operative debridement of the wound and fracture.1 Treatment with antibiotics alone or even without antibiotics and only local wound care has been shown to be safe. Missile injuries to the pelvis and abdomen can potentially penetrate the intestines leading to fecal spillage requiring laparotomy, irrigation, and debridement, with intestinal repair or colostomy and antibiotic treatment.2–7 When this same missile also penetrates the bony pelvis, there is the potential risk of fecal contamination of the pelvic fracture site, potentially requiring orthopedic fracture debridement that is not typically done as a routine part of the laparotomy. The aim of this study is to determine whether orthopedic debridement of a gunshot pelvic fracture is necessary in cases of concomitant intestinal hollow viscus injury by performing a retrospective review at an urban Level I trauma center.

MATERIALS AND METHODS

An Institutional Review Board-approved retrospective chart and radiographic review of all patients older than 12 years presenting to an inner city Level I trauma center in the United States during the period 2003–2008 was performed. Both an orthopedic inpatient database and a trauma database (Pennsylvania Trauma Systems Foundation [PTSF] database) were searched for pelvic fractures with gunshot injuries. The orthopedic inpatient database did not exist before 2004, so no data from this database are available from 2003 to late 2004. Each list was cross-checked for duplicate entries. Patients were excluded if death occurred within 48 hours of injury or if the firearm was obviously a shotgun. Patients were also excluded if there was no evidence of a gunshot pelvic fracture on radiographic and computed tomographic review. To be included, a fracture of the ilium, ischium, pubis, or sacrum was required. Lumbar spine fractures were not included. Any cases with a gunshot through the pelvis to the hip joint were included. The following data were compiled after both chart and radiographic/computed tomographic review: patient age, sex, location and type of fracture, hip joint involvement, infection, presence of abdominal viscus injury, general surgical treatment, and orthopedic surgical treatment. Infection as diagnosed clinically and confirmed by positive cultures was a major outcome parameter. Only infections diagnosed during the index admission or requiring readmission were
recorded. All radiographs and computed tomographic images (if performed) were reviewed for all patients by the authors. Fracture pattern, location, and presence of hip joint penetration were identified.

RESULTS

Of a total of 8,917 trauma admissions and 1,422 patients with gunshot injuries admitted, 101 patients were identified by the PTSF database, and 18 were identified with the orthopedic inpatient database search. Of these 18 patients, 16 patients were also included (cross-matched) in the PTSF database list. Therefore, 2 remaining patients were added to the list of subjects for a total of 103 patients. Of this 103 patients, 19 patients expired within 48 hours and therefore were excluded. After these exclusions, a total of 84 subjects (80 males and 4 females) were identified as patients treated from August 2003 through December 2008 with a gunshot pelvic fracture who survived beyond the initial 48 hours. The average age was 27.2 years (range, 13–71 years). The data for the following sections are summarized in Table 1. All but one patient were treated with intravenous antibiotics, although the specific drugs and duration of treatment differed.

Perforated Viscus Injury

Fifty of 84 patients (59%) had a perforated viscus from the gunshot missile injury. All 50 patients underwent exploratory laparotomy or laparoscopy. There were 31 large bowel injuries and 30 small bowel injuries (11 patients had both large and small bowel injuries). All but one patient were treated with varying courses of intravenous antibiotic therapy. Of these 50 patients, 6 patients had a concomitant intra-articular fracture and therefore joint involvement of the hip, whereas the remaining injuries were extra-articular (Fig. 1). Of these six patients, two had retained bullets in the hip joint and four did not have any retained fragments. Urgent irrigation and debridement were done only for the two patients with retained bullets.

Intra-Articular Injury

Eighteen patients were identified as having intra-articular injury (3 sacroiliac, 15 hip joint). In eight cases (0 sacroiliac, 8 hip joint), bullet fragments remained in the joint space. Of these 18 patients, 7 patients (all with bullets remaining in the hip joint or in continuity with the joint space) underwent arthroscopy or arthroscopy with irrigation, debridement, and removal of the bullet fragment(s). Two of these eight patients with bullet fragments in the hip joint also had concomitant intestinal viscus injury. One of these two patients developed a septic hip joint requiring multiple irrigation and debridement procedures (Table 2). This patient underwent irrigation and debridement of the hip joint on the day of the injury but with unsuccessful bullet removal (Fig. 2). Sigmoid colon injury required diverting colostomy at the initial procedure. Bullet removal was done in a repeat procedure 2 days later. Serial irrigation and debridement procedures followed after infection developed until resolution of the infection. This patient went on to develop severe heterotopic ossification of the hip joint.

Six of the 15 patients with hip joint involvement also had a perforated viscus abdominal injury (Table 2). Two of these had retained fragments and underwent debridement as mentioned above, but the other four patients did not undergo debridement procedures.

Complications

As described above, 1 patient of 84 total cases developed an acute infection (Fig. 3). As described in the previous section (“intra-articular injury”), this patient had a sigmoid colonic injury with concomitant hip joint injury with a retained missile in the joint. No other cases of infection were identified in this series either during the initial hospital admission or with readmissions or subsequent procedures done after discharge from the initial admission.

Fracture Locations

Of the 84 patients, 42 cases involved the ilium, 8 ischium, 15 pubis, 16 sacrum, 15 acetabulum, and 3 sacroiliac joint (Fig. 4). Several cases involved multiple fractures, explaining the total of 96 fractures in 84 patients. Because these were fractures caused by missile injury and not blunt trauma, commonly used classification schemes (such as Young-Burgess or Tile) were not used.

DISCUSSION

The majority (59%) of low-velocity gunshot injuries to the pelvis resulting in fractures also resulted in abdominal viscus injuries with potential contamination. The degree of

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<th>Table 1. Summary of Data</th>
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<tr>
<td>Total Patients</td>
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<tr>
<td>84</td>
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Figure 1. A computed tomographic scan image of a patient with a gunshot injury with large bowel injury and a concomitant iliac wing fracture (extra-articular).
initial contamination certainly varied from case to case and is unfortunately difficult to quantify. Treatment with exploratory laparotomy and intestinal repair was done for all 31 cases of large bowel and rectal injuries and 30 cases of small bowel injuries. Nevertheless, it is clear from the results of this study that hollow viscus injuries with potential bony contamination are common with gunshot pelvic fractures.

Patients who had viscus injury as well as fracture were treated with abdominal exploration, repair of intestinal injuries, and washout by the trauma surgeon if indicated. Bony debridement was performed by the orthopedic surgeon only in cases of hip joint penetration with retained intra-articular bullet fragments. Neither fracture debridement nor any form of internal or external fixation was performed in any extra-articular fractures. With this treatment protocol, there were no obvious cases of acute osteomyelitis, but there was one case of septic arthritis in a patient who did undergo an initial arthrotomy with irrigation and debridement of the hip joint. Unfortunately, a subsequent arthrotomy was required to remove the bullet that could not be retrieved in the initial procedure. This patient went on to develop septic arthritis requiring multiple drainage procedures until it resolved. Ultimately, this patient developed severe heterotopic ossification of the hip joint.

Retained intra-articular bullets have been demonstrated in several studies to have detrimental effects on synovial joints, leading to lead synovitis, arthritis, and systemic lead poisoning.8–15 Joint arthrotomy and removal of bullets and foreign bodies are standard orthopedic practices. Arthroscopic and alternative open techniques have also been described for successful removal of bullets from the hip joint with concomitant irrigation and debridement.16–21

The risk of clinically significant hip joint infection with gunshot injuries has been reported in several studies.7,22–25 Becker et al.22 reported on 49 patients with gunshot injuries to the hip, five of whom had concomitant abdominal visceral injuries. Four of these five patients developed infection with poor functional outcomes. Long et al.24 cautioned on the high risk of septic arthritis in civilian gunshot injuries with concomitant bowel injury. In their series, selected cases with minimal bone disruption and without bowel injury were successfully treated without arthrotomy. However, patients with retained bullets left alone in contact with the joint and

<p>| Table 2: Patients With Hip Joint and Sacroiliac Intra-Articular Joint Involvement From Gunshot Injury |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|</p>
<table>
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<tr>
<th>Intestinal Perforation</th>
<th>Retained Bullet</th>
<th>Viscus Perforation and Retained Bullet</th>
<th>Infection</th>
<th>Underwent I + D of Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip joint (15 patients)</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Sacroiliac joint (3 patients)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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One patient with infection did undergo initial debridement, but removal of bullet was done at a repeat debridement before infection developed.
patients with concomitant bowel injury did poorly. We have
demonstrated similar findings in our study with six patients
with hip joint penetration treated successfully nonoperatively
with antibiotics alone. Also similarly, one infection occurred
in a patient with hip joint involvement, a retained intra-
articular bullet, and concomitant bowel injury despite I + D
and bullet removal. In addition, our practice of removing
retained intra-articular bullet fragments regardless of bowel
injury is similar to theirs.

Sacroiliac joint injuries with retained bullets from low-
velocity gunshot injuries can potentially lead to infection,
although this was not seen in this series or other series
reviewed here. Techniques for removing bullets percutane-
ously from the sacroiliac joint have been described, although
this was not used in our series.26

Gunshot injuries of the spine have been the focus of
several published manuscripts in the orthopedic literature.
Although many authors have concluded that most spinal
fractures from gunshot injuries are inherently stable and do
not require internal stabilization, others have pointed out that
certain injury patterns do require stabilization.27,28 With re-
gard to infection, intestinal injury has been recognized as a
risk for spinal infection.27–31 Although antibiotic treatment is
recommended, the role of surgical debridement is unclear.
In a series of 13 patients with low-velocity gunshot injuries with
missiles passing from the colon or rectum into the spine,
antibiotic treatment alone was successful in preventing
spinal osteomyelitis or disk infection, despite the increased
incidence of intra-abdominal abscess and peritonitis.29
Surgical debridement is recommended by some but was
found to have a higher incidence of spinal infection by
others.30,31 In a series of 27 patients with transgastrointes-
tinal gunshot injuries to the spine, there was a significa-
tively higher rate of spinal infection with surgical treatment
than with nonsurgical treatment.31

Low-velocity gunshot fractures to the extremities are
generally treated in a similar fashion as closed fractures rather
than as open fractures. That is, urgent debridement is not
typically done because it is for other open fractures. How-
ever, in cases of gross contamination or exposed bone frag-
ments, debridement is done in the usual fashion for open
fractures. The patients in our study who had viscus perfora-
tion and spillage of intestinal contents did not undergo formal
debridement of the pelvic fracture unless the hip joint was
involved. None of the pelvic fractures in this study required
operative reduction and/or fixation. Formal orthopedic oper-
ative debridement of the pelvic fractures would require either
a separate surgical approach to the pelvis or a repeat laparot-
omy with concomitant deeper approach to the bony pelvis.
The only infection known to have occurred in this study was
in a patient who had a gunshot injury to the hip joint, despite
an initial arthrotomy and washout procedure. Therefore, the
data in this study suggest that surgical debridement of extra-
articular pelvic gunshot fractures is not required, even in
cases of viscus perforation and bowel spillage of the large or
small bowel.

Intra-articular hip gunshot injuries without retained
bullet fragments did not undergo debridement in this series,
even in certain cases involving perforated viscus. In many
cases, it is uncertain whether the same missile that caused the
perforated viscus also penetrated the hip joint. Our current
practice is actually to perform debridement procedures if
there is any question about possible concomitant abdominal
viscus injury, despite the findings in this study. Furthermore,
gunshot wounds to the hip joints without fracture were not
investigated in this retrospective study. Many of these inju-
ries result in retained bullet fragments with or without con-
comitant viscus injury.

There are several shortcomings of this study. Only
emergency department, initial inpatient, and readmission in-
patient records were reviewed. Outpatient records from the
clinic were not reviewed, so wound infections that did not
require operative debridement or intravenous antibiotic treat-
ment would not have been identified in this study. Deep bony
infections could also have occurred without being diagnosed
or with follow-up elsewhere. However, it is most likely that
if a deep bone infection were to occur relatively acutely, a
diagnosis would have been made during the initial inpatient
stay or would have resulted in a readmission to the hospital.
It is our practice to treat deep bone infections routinely with
debridement and antibiotics. Finally, our data from the data-
base and review of the medical records did not distinguish
firearm or ammunition type suspected. High-energy ballistic
injuries such as those by shotgun or assault rifles are a higher
risk for infection and are typically treated with urgent irriga-
tion and debridement. Shotgun injuries in our series were
more easily recognized by clinicians and by radiographic
review and therefore were excluded. However, it is possible
that some of our injuries may have been caused by newer
ammunition and more high-powered firearms. These weap-
ons are implicated in causing far more soft tissue injury than
traditional handguns but are not easily distinguished in our
retrospective review.

In conclusion, the data in this study suggest that ortho-
pedic debridement of extra-articular pelvic fractures resulting
from low-velocity gunshot injuries is not required, even in
cases of concomitant intestinal spillage. Exploratory laparot-
omy with intestinal repair and washout by the trauma surgeon
with antibiotic treatment is a sufficient treatment. However,
retained intra-articular hip joint bullet fragments do increase
the risk of infection as has been suggested in other studies.
Arthrotomy and debridement should be performed in these
cases.

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