EXTERNAL FIXATION OF UNSTABLE PELVIC FRACTURE

Nguyen Van Ninh¹; Nguyen Tien Binh²
Pham Dang Ninh³; Nguyen Ba Ngọc³

SUMMARY

Objectives: To give some remarks on treatment results of the unstable fractures of the pelvic ring by external fixation on the prevention of shock, anatomical recovery and rehabilitation. Also, we gave some comments on indications, techniques and complications. Subjects and methods: 71 patients with unstable fractures of the pelvic ring type B and type C according to Tile M’s classification were treated by external fixation at 103 Military Hospital and National Institute of Burns from May 2010 to Feb 2017. Among them, we conducted a prospective study on 49 patients and a retrospective one on 22 patients. External frame by the reversed pressed bars by professor Nguyen Van Nhan, four Ø 4.5 mm Schanz pins are placed in the iliac crests. Early results: 69 patients became stable, out of shock (97%); 2 deaths due to shock; reduction: good 56 patients (78.9%), fair: 8 patients (11.3%), average: 4 patients (5.6%); poor: 3 patients (4.2%). After fixation, patients had less pain and could recover quickly. Far results: 62 patients (87.32%), follow-up from 6 to 78 months, average 33.74 months. 100% of pelvic fractures are healed. The functional outcome was evaluated by using a scoring system by Majeed (1989). Clinical findings: Good 52 patients (83.9%); fair 3 patients (4.8%); average 4 patients (6.5%); poor 3 patients (4.8%). Conclusion: Treatment of unstable pelvic fracture by the external fixation had good results with simple, easy procedure. Pelvic fracture was fixed firmly to reduce the pain, stop bleeding, prevent shock, convenient for treating the patient.

* Keywords: Unstable pelvic fractures; External fixation.

INTRODUCTION

Pelvic fracture is a common injury and is usually severe. According to Melton’s statistics (1981) in 10 years (1968 - 1977) at Minnesota, there was an estimated 37 patients/100,000 persons/1 year suffering from pelvic fracture [1]. In Vietnam, according to Ngo Bao Khang (1995) in Cho Ray Hospital, pelvic fracture ranged from 3 - 5% of total bones fracture [1]. Pelvic fractures are often in the context of multiple injuries and often with combined lesions, so the mortality rate was so high. Main cause was due to traffic accidents. Lindahl (1999) did a research on 110 patients with unstable pelvic fracture treated by external fixator frames, among whom, 62% related to traffic accidents, 28% of high falls, and 10% from high powerful trauma, mortality rate was 12% [7]. In Vietnam, according to Ngo Bao Khang [1] (1995) and Nguyen Duc Phuc (2004) [2], 50% were due to traffic accidents.

The classic treatment for pelvic fracture allows the patient to lie motionless,
to bandage around the pelvis, traction..., although it is simple and easy to do. However, the results of recovery of anatomy are not good, patients remain immobile for a long time.

Internal fixation give good results of recovery of anatomy, the patients can move early, avoid the complications because of motionlessness for a long time, but it is a complicated surgery, this technique can not be done in the emergency stages and with open pelvic fractures.

In recent years, the devices for external fixation have become popular for the treatment of unstable injuries of the pelvic ring. Compared with conservative treatment, this technique brought better results but anterior external fixation frame soon exposed its limitations when used for the most unstable injuries, especially in the posterior part of the pelvic ring [3, 4, 8, 9].

Pelvic fractures cause a lot of blood loss, the patient is very painful, often shocking. Therefore, there have been many foreign and domestic surgeons using external fixator frames for emergency pelvic fracture treatment for the purpose of correction and fixation of pelvic fractures, preventing shock, facilitating the management of combined lesions and prophylaxis complications. Over the years, the Department of Orthopedics and Trauma, 103 Military Hospital has applied external fixation method by the reverse threaded pressed rods by Nguyen Van Nhan to treat pelvic fractures and obtained very satisfactory results [3]. We study this subject aiming:

- To assess the results of treatment of unstable pelvic fracture by external fixation on anatomical recovery and functional outcome.
- To give some remarks about the indication and technique.

SUBJECTS AND METHODS
1. Subjects.
Between May 2010 and Feb 2017, we treated 71 consecutive patients with an unstable fracture of the pelvic ring by closed reduction and a external fixator. Among 71 patients, there were 41 women and 30 men.

- Prospective study on 49 patients and retrospective study on 22 patients.
- Instruments for external fixation:
  + 2 reverse threaded pressed rods of Nguyen Van Nhan (35 cm in length).
  + 4 Schanz pins: 4.5 x 180 mm in diameter.
  + Driller by hand and electrical driller, diameter of drill = 3.5 mm.

Figure 1: A. Instruments for external fixation. B. Model of unstable pelvic fracture. (Source: the images from the research)
* Technique:

Drill and insert 2 Schanz pins (diameter 4.5 mm, length 180 mm) into each iliac crest, distance between 2 pins was 3 - 4 cm. Installed 2 reverse threaded pressed rods with the Schanzs, then linking two rods by two Steinman pins (diameter 4.5 x 100 mm length) make the external fixator frame.

Use the wrench 10 to turn gradually, to press the surface of the pelvic fractures or joints close together. X-ray was taken when the patient's body was stabilized to correct displacement of the pelvic fractures or joints. The external fixator frame was maintained 8 - 10 weeks.

![Figure 2: External fixation frame. (Source: the images from the research)](image)

* Evaluation of outcome:

The functional outcome was measured using a scoring system described by Majeed (1989), which is based on the clinical examination [10].

Functional outcome (total score): good > 85; fair: 70 - 84; average: 55 - 69 and poor < 55.

* Statistical analysis: by SPSS software 16.0.

RESULTS

1. Characteristics.

- Causes of injuries: Mainly by traffic accident (39/71 patients = 54.9%); falling: 20/71 patients (28.1%) and different accidents: 12/71 patients (17%).

- 37 patients had shock (52.1%), in which: 20 patients (28.2%) were shocked but had stable treatment at the frontal hospital; 17 patients (23.9%) were shocked when they came to hospital (10 cases were treated stable, then made the external fixation, 7 cases of emergency surgery were fixed external frame: 5 cases got over shock and returned stability, 2 deaths from other organ diseases).

- We used Tile M's classification (2003) [9]: type B1 + B3 (open book pelvic fracture: 22 patients = 30.9%). type B2 (close book pelvic fracture: 36 patients = 50.7%). Type C: Completely unstable fracture: 13 patients = 18.3%.
2. Combined lesions.
- 14 cases had brain injury (2 cases of brain trauma had surgery).
- 8 cases suffered from closed abdominal trauma: rupture of the rectum: 3 cases, rupture of the small intestine: 1 case.
- 10 cases had large retroperitoneal hematoma.
- 8 cases had closed thoracic trauma.
- 12 cases had urology trauma: Urethral rupture in men (2 cases); bladder rupture (4 cases); vaginal discharge (2 cases); muscul tissues wounds (4 cases).
- 42 cases had other bones or joints injury.
- 2 cases had burn: 1 case of electrical burn with 17% of head, face, neck, body. 1 case of gas burn with 60% of face, neck, body, legs.

3. Early results.
X-ray examination after external fixation noticed that the anatomical recovery of pelvis of 69 patients, in which good level: 56 patients (81.2%); fair level: 8 patients (11.6%); average level: 2 patients (2.9%); poor level: 3 patients (4.3%).

The technique of fixation achieved 100%.
Convenient for taking care and treating the rated injuries.
Schanz pins were in the correct position, in the bone of the iliac crests.
The time for healing pelvic fractures and releasing the frame: 8.45 weeks.
Complications of Schanz pins infection: 22/69 patients (31.0%), 51/276 pins (18.47%). Infections were treated (grade III): 8/51 pins (16%).

Table 1: Anatomical recovery results (n = 69).

<table>
<thead>
<tr>
<th>Classification</th>
<th>Anatomical recovery results</th>
<th>Total (n, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good (n, %)</td>
<td>Fair (n, %)</td>
</tr>
<tr>
<td>Type B1 (open book - fracture)</td>
<td>18 (26.1)</td>
<td>3 (4.3)</td>
</tr>
<tr>
<td>Type B2 (close book - fracture)</td>
<td>33 (47.8)</td>
<td>1 (1.4)</td>
</tr>
<tr>
<td>Type C</td>
<td>5 (7.2)</td>
<td>4 (5.8)</td>
</tr>
<tr>
<td>Total (n, %)</td>
<td>56 (81.2)</td>
<td>8 (11.6)</td>
</tr>
</tbody>
</table>

- Follow-up: 62/71 patients (87.32%), 9 patients without far results (7 patients lost address, 2 deaths).
- The time for assessing long-term results: the shortest was 6 months, the longest 78 months, average: 33.74 months (average 33.74 months).
- Functional outcome: Good: 52 patients (83.9%); fair: 3 patients (4.8%); average: 4 patients (6.5%); poor: 3 patients (4.8%).
Table 2: Functional outcome (n = 62).

<table>
<thead>
<tr>
<th>Classification</th>
<th>Good (n, %)</th>
<th>Fair (n, %)</th>
<th>Average (n, %)</th>
<th>Poor (n, %)</th>
<th>Total (n, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type B1 (open - book fracture)</td>
<td>16 (25.8)</td>
<td>2 (3.2)</td>
<td>1 (1.6)</td>
<td>0 (0.0)</td>
<td>19 (30.6)</td>
</tr>
<tr>
<td>Type B2 (close - book fracture)</td>
<td>29 (46.8)</td>
<td>1 (1.6)</td>
<td>1 (1.6)</td>
<td>1 (1.6)</td>
<td>32 (51.6)</td>
</tr>
<tr>
<td>Type C</td>
<td>7 (11.3)</td>
<td>0 (0.0)</td>
<td>2 (3.2)</td>
<td>2 (3.2)</td>
<td>11 (17.7)</td>
</tr>
<tr>
<td>Total (n, %)</td>
<td>52 (83.9)</td>
<td>3 (4.8)</td>
<td>4 (6.5)</td>
<td>3 (4.8)</td>
<td>62 (100.0)</td>
</tr>
</tbody>
</table>

5. The connection between anatomical recovery and functional outcome (n = 62).

Table 3:

<table>
<thead>
<tr>
<th>Anatomical recovery results</th>
<th>Good (n, %)</th>
<th>Fair (n, %)</th>
<th>Average (n, %)</th>
<th>Poor (n, %)</th>
<th>Total (n, %)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>49 (79.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>49 (79.0)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Fair</td>
<td>3 (4.8)</td>
<td>3 (4.8)</td>
<td>2 (3.2)</td>
<td>0 (0.0)</td>
<td>8 (12.9)</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (3.2)</td>
<td>0 (0.0)</td>
<td>2 (3.2)</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
<td>3 (4.8)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>52 (83.9)</td>
<td>3 (4.8)</td>
<td>4 (6.5)</td>
<td>3 (4.8)</td>
<td>62 (100)</td>
<td></td>
</tr>
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</table>

49 patients had good anatomical recovery results and functional outcome. 3 patients had poor anatomical recovery results and functional outcome. The connection between anatomical recovery and functional outcome was statistically significant, p < 0.05.

DISCUSSION

1. Indications.
According to Tile M, to choose a treatment method for patients with pelvic fractures must firstly be based on the patient’s overall condition and pelvic fracture classification which is currently being used by many surgeons. For type A fractures (stable pelvic fractures), if there are no associated injuries, the patient will be immobile for 4 weeks. Type B fractures (B1, B2) are not completely unstable pelvic fractures (unstable rotation and stable vertical) and type C, which completely unstable fractures (both rotation and vertical): Need to undergo surgery to stabilize the pelvic bone, the reason we choose the method is:

First, this is a solid fixation method, simple, noninvasive and safe technique. This can be done in the emergency room and can do in the resuscitation stages.
### Table 4: Some authors’ functional results.

<table>
<thead>
<tr>
<th>Author</th>
<th>Patients (n)</th>
<th>Good (n, %)</th>
<th>Fair (n, %)</th>
<th>Average (n, %)</th>
<th>Poor (n, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michelangelo S [12]</td>
<td>41</td>
<td>12 (29.0)</td>
<td>18 (44)</td>
<td>7 (17)</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Rommens P.M [13]</td>
<td>122</td>
<td>57 (46.7)</td>
<td>36 (29.5)</td>
<td>24 (19.7)</td>
<td>5 (4.1)</td>
</tr>
<tr>
<td>Nguyen Ngoc Toan [5]</td>
<td>81</td>
<td>22 (27.2)</td>
<td>30 (37.0)</td>
<td>20 (24.7)</td>
<td>9 (11.1)</td>
</tr>
<tr>
<td>Our research</td>
<td>62</td>
<td>52 (83.9)</td>
<td>3 (4.8)</td>
<td>4 (6.5)</td>
<td>3 (4.8)</td>
</tr>
</tbody>
</table>

Thus, the results of the study are much more different from other authors’ findings with a good rate of 83.9%. The reason was that our long-term follow-up averaged 33.74 months compared to 25.6 months in Nguyen Ngoc Toan’s study and 21.6 months in Rommens P.M’s study.

Patients with severe and complex injuries got over shock and good functional outcome. It demonstrates that our method was accurate. Long-term follow-up was done for 62/69 patients (89.8%), the shortest was 6 months, the longest was 78 months, mean: 33.74 months.

2. Technique.

We shared the same idea as European authors that external fixation should be done as soon as possible [7, 9], as the important goal is to relieve pain and stop bleeding. Therefore, if patients with combined lesions need surgery, patients should be placed on the operating room and fixed pelvis after closing the abdominal surgery. If the patient does not have intra-abdominal injury, we can do at their ward and need to do early after excluding the abdominal emergency.

The position of Schanz pins placement: We chose the iliac crest to insert because this position is right under the skin, easy to do and can avoid blood vessel damage, organ damage in the abdomen. Some authors also pierce the pins in the pubis, which creates better force for frame, but this technique requires drilling pins to prevent the organs from the injury.

First, drill through the pelvic shell by countersink (diameter 3.5 mm), then use a hand drill to catch the pins. Make sure the pins are pierced to the iliac crest. When using a sharp pins, they can be pierced directly to the iliac crest and drilled slowly. If we drill through the side of the bony shell, the pins is no longer firmly attached to the bone. Normally after incision, we use the tip of pins to probe the thickness of the iliac crest before drilling and placing the pins in the center.

We should place the frame 4 - 5 cm far from the skin of the abdominen, which is enough to care the abdominal incision, if any.

Why choose the reverse threaded pressed rods by Nguyen Van Nhan: This is a frame that military doctors usually use because of simple structure, solid fixation and they are available in military hospitals. They can be used for many fractures,
convenient for preservation, use in the frontline in combat conditions or mass rescue.

3. Anatomical recovery results.

- Reduction of type B1 pelvic fracture (open book fracture): Patients usually have pelvic ring injury with a symphysis pubis dislocation and sacroiliac joint dislocation. In this case, to reduce an unstable pelvic fractures in the inner rotation, we must turn to press 2 rods of external fixation together, but we must turn gradually and alternately one by one, 1 round of rod can narrow the distance 2 mm, the reverse threaded pressed rods by Nguyen Van Nhan can apply to treat unstable pelvic fractures and two Ø 4.5 mm Schanz pins are inserted into iliac crests on each side and can be reduced and fixed firmly.

- Reduction of type B2 pelvic fracture (close book fracture): We usually see that the patients have this injury with pubis fracture in anterior and dislocation of sacroiliac joints in the posterior half of the pelvis. Clinical results show that with B2.1 fracture, two Schanz pins are inserted into each side of the pelvic crests can be reduced pelvis on outer rotation and fixed firmly.

- Reduction of type C pelvic fracture (rotational and vertical displacement): For this type of injury, firstly, traction to reduce upward displacement of hemipelvis (weight of 8 - 10 kg), X-ray to review if hemipelvis is horizontal with the other side, the external fixator frame is applied to reduce the pelvis in the anatomical position.


We agreed with European authors about using Majeed's rehabilitation assessment (1989) [11]. 62/69 patients (89.9%) were followed long-term; good and fair functional outcome: 88.7%. In the study, most cases had good anatomical recovery results and functional outcome. The connection between anatomical recovery and functional outcome was statistically significant (p < 0.05).

CONCLUSION

- External fixation: Simple, easy to fix the pelvic fracture, reduce pains, stop bleeding, prevent shock and treat the complex injuries.

- Convenient for taking care and treating patients and could avoid the complications occurrence while the sick person remains motionless for a long time.

- Anatomical recovery result (n = 69): good: 56 patients (81.2%); fair: 8 patients (11.6%); average: 2 patients (2.9%); poor: 3 patients (4.3%).

- Long-term result: Pelvic fractures was healed: 100%. Functional outcome (n = 62): good: 52 patients (83.9%); fair: 3 patients (4.8%); average: 4 patients (6.5%); poor: 3 patients (4.8%).

- The patients had good anatomical recovery results and functional outcome.

- External fixation had good ability of reduction with type B fractures (open book and close book fracture). To limit reduction of type C (rotational and vertical
displacement): For this type of injury, firstly, traction to reduce upward displacement of hemipelvis before external fixator frame was applied.

- The time of external fixation: As soon as possible.
- Indications: Unstable pelvic fracture (type B, C - Tile M's classification).

REFERENCES


