

# PELVIFEMORAL EXTERNAL FIXATION FOR THE TREATMENT OF OPEN FRACTURES OF THE PROXIMAL FEMUR CAUSED BY FIREARMS

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Seventeen patients with open fractures of the upper third of the femur were treated using a pelvifemoral external fixation device. All of them had grade III open fractures resulting from high-velocity missile and explosive injuries with massive foreign body contamination.

Sciatic nerve injury was present in five (29.4%); abdominal viscera and thoracic wall injuries were present in two patients (11.8%). There were no major arterial injuries.

Full weight bearing was allowed after clinical and radiological bone healing (average 11.5 months). Chronic osteitis with fistula and sequestra developed in two (11.8%) patients. There were no nonunions and no refractures. Minor painless limitation of hip motion persisted in all patients.

Upper-third femoral open fractures due to firearms are a unique type of open fractures. They are usually highly comminuted; therefore, stable fixation is difficult or impossible to achieve using external fixation with transfixation of the fracture site. On the other hand, the risk of infection is high following intramedullary nailing.

Pelvifemoral external fixation allows adequate management of the soft tissue wounds, provides stable bone fixation and allows early patient mobilization.

**Keywords** : fracture ; proximal femur ; firearm ; external fixation.

**Mots-clés** : fracture ; fémur proximal ; arme à feu ; fixation externe.

## INTRODUCTION

Open fractures of the proximal femur due to firearms are difficult to manage because of com-

minution at the fracture site. There is also difficulty in maintaining a correct cervicodiaphyseal angle. These compound lesions include missile tracks, extensive soft tissue injuries and open fractures, and may involve nerves and joints. Besides, there is a high rate of wound contamination.

The goals of treatment of such injuries are prevention of infection and achieving reduction and stable fixation in a good position. The previous use of intramedullary Gamma nailing or external fixation with the proximal pins inserted from the base of the greater trochanter into the femoral head (fig. 1) did not yield good results. Collapse of the neck-shaft angle on weight bearing was a common occurrence; moreover, pin-tract infection often led to bone infection and septic arthritis of the hip joint.

The aim of this paper is to review our experience with the use of a pelvifemoral external device for the treatment of open fractures of the proximal femur caused by firearms.

## PATIENTS AND METHODS

From 1991 to 1995, 17 patients with open fractures of the proximal third of the femur were treated using a

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**Fig. 1.** — *a.* Xray of a compound fracture of the proximal femur two months after Gamma nailing with subsequent infected nonunion. *b.* Collapse of the fragments after two months of external fixation, in another compound fracture of the proximal femur with all pins on the femur.

pelvifemoral external fixation device at the Institute of Orthopaedic Surgery and Traumatology in Belgrade.

All of them had grade III open fractures resulting from high-velocity missile or explosive injuries with massive contamination by foreign bodies (3). There were 12 males and 5 females. Nine patients had penetrating wounds in the gluteal region; penetrating wounds in the anterolateral aspect of the upper thigh were noted in eight patients.

After primary treatment at the nearest hospital, the patients were transported to our institution. Reduction and external fixation were performed in our hospital within 2 to 5 days after injury (average 3.5 days). We used a unilateral external device designed by Mitkovic (6).

Sciatic nerve injury was found in 5 of 17 patients (29.4%); abdominal viscera and thoracic wall injuries were present in two patients (11.8%). There were no major arterial injuries.

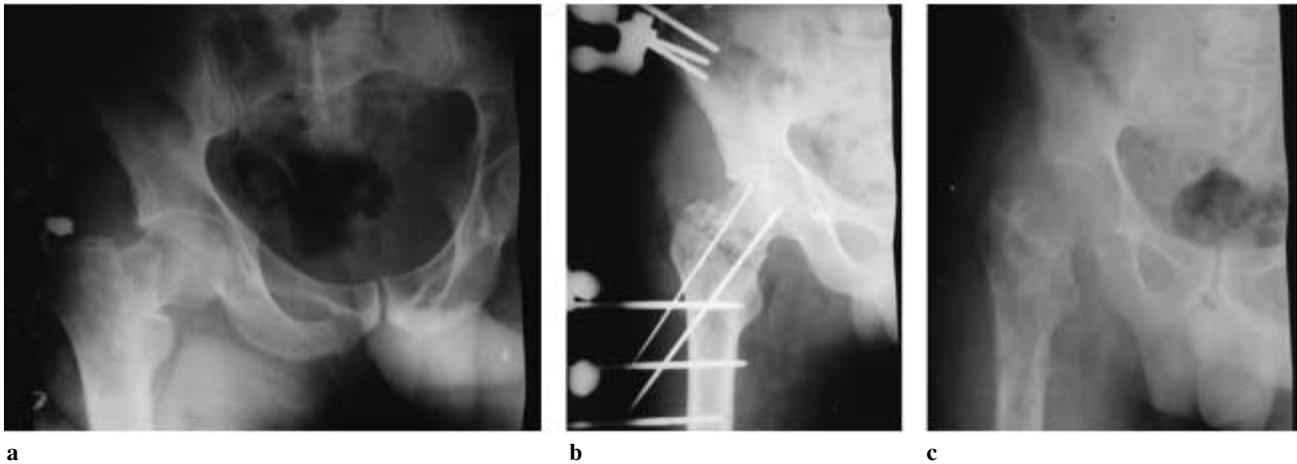
**Technique.** Under general anesthesia, the patient was placed on a fracture table in the supine position. Reduction of the fracture was performed by manipulation under radiological control. Through skin incisions, three 5 - mm Schanz screws were inserted in the iliac crest of the ilium on the side of the injured femur. The screws were passed into the cancellous bone between

the inner and outer pelvic tables, 5 to 6 cm deep. Three or four 6 - mm Schanz pins were then percutaneously inserted at right angles into the lateral side of the femoral shaft. The clamps were attached to each pin and the two sets of pins were then connected with a straight rod, the clamps were tightened and the final position checked radiologically. Thereupon, copious irrigation with 5 000 to 10 000 ml. of saline solution and surgical debridement was routinely done. Wounds were covered with an iodine dressing (4). We performed secondary wound closure in 15 (88.2%) patients and split-thickness skin graft covering in two (11.8%) patients. Wound closure was done after one to three weeks (average 1.9 weeks). Prophylaxis for tetanus was administered when indicated by history. A cephalosporin and an aminoglycoside were given intravenously for three days.

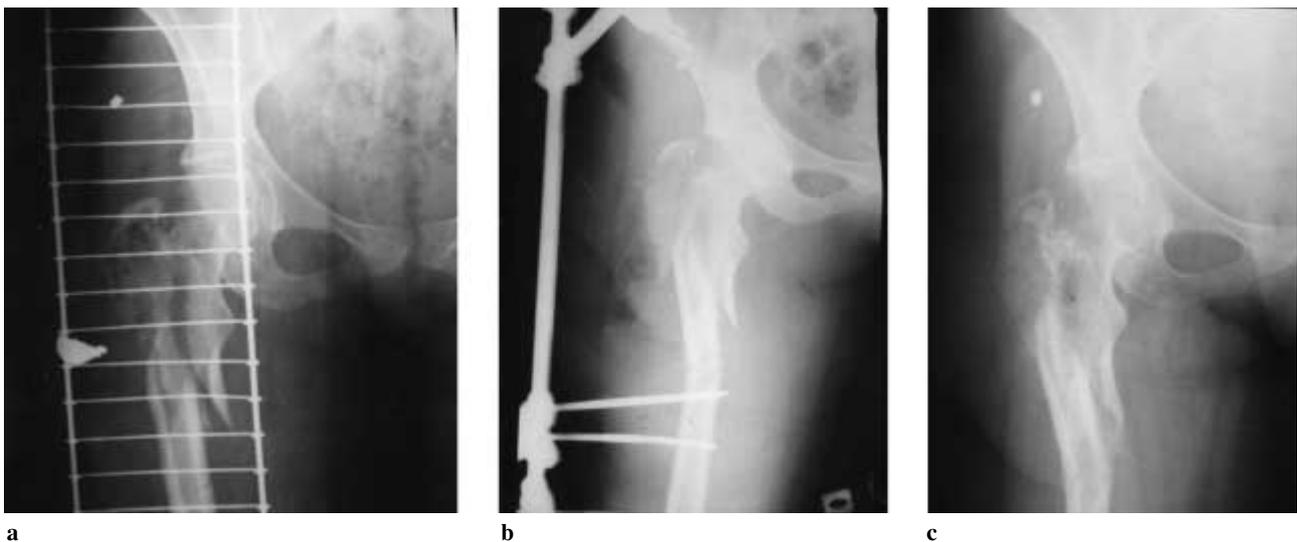
As soon as possible, depending on the presence of other associated injuries, the patients were encouraged to walk using crutches without weight bearing on the injured leg.

## RESULTS

The average time to union for all 17 fractures was 11.5 months. The mean follow-up was 7 years (ranging from 5 to 9 years) (figs. 2, 3).



**Fig. 2.** — *a.* Pre-operative radiograph of intraarticular fracture due to gunshot injury. *b.* Post-operative radiograph after reduction and fixation with a pelvifemoral fixator. *c.* Four years after external fixation.



**Fig. 3.** — *a.* Compound intertrochanteric fracture resulting from an explosive injury. *b.* Post-operative radiograph after reduction and fixation with a pelvifemoral fixator. *c.* Three years after external fixation.

All half pins had to be removed in one patient after 2 months, owing to deep pin-tract infection ; alignment was maintained by balanced skeletal traction through a tibial pin for the next four months. Chronic osteitis with fistula and sequestra developed in two (11.7%) patients. Of all distal pins only one broke, and a single proximal pin loosening occurred in three patients.

Leg shortening less than 2 cm, due to inadequate reduction, was recorded in three (17.6%) patients. Limitation of hip and knee motion was noted in all patients. The range of knee movement was 80° to 120° (average 98°), and the range of hip movement was 65° to 105° (average 98°). There were no nonunions, no refractures, and no late collapse of the fragments.

## DISCUSSION

Open fractures of the proximal third of the femur due to firearms are a unique type of open fractures. They are usually highly comminuted; therefore, rigid internal fixation using intramedullary nails or external fixation with the fixation pins into the proximal and distal fracture fragments is difficult or impossible to achieve. Although our method provided a flexible form of fixation, our results have shown that pelvifemoral external fixation has maintained the neck-shaft angle and secured its position. Furthermore, this method has allowed early ambulation of the patients.

The role of internal fixation in open fractures remains controversial (1), but many authors have reported the use of primary internal fixation in open fractures with good results and an acceptable rate of complications (5, 8, 10). Avoiding pin penetration through the proximal femoral fragment, we believe, reduced the incidence of infection at the fracture site. Moreover, operative irrigation, repeated aggressive surgical debridement in 48 to 72 hours after fixation and intravenous administration of two separate antibiotics were routinely performed in the treatment of such injuries (7).

Of the five patients who had sciatic nerve injury, recovery of nerve function occurred in only one. Orthotic support was used in patients who had residual neural deficits. Although none of the patients in our series had exploration of the sciatic nerve, this surgical procedure may be indicated in three to six months (9).

In 1991, Dhal *et al.* (2) published a series of 154 intertrochanteric femoral fractures treated by external fixation. Among them, the authors described two cases of grade III open fractures resulting from gunshot wounds. The average time to union of open fractures was 28 weeks. Our experience with high-energy injuries of the proximal femur is somewhat different from their report. In our series, bone union took much longer: 46 weeks. Late collapse of fragments occurred in both open fractures in their series because of weight bearing. No collapse of the neck-shaft angle was noted in our patients. In our opinion the statement of Dhal *et al.* regarding union time is probably too optimistic.

Although we accept differences in the nature of the weapons which caused the injuries (low - and high - velocity missiles), the union time of these types of open fractures should be considered longer than 28 weeks as shown by secondary collapse on weight bearing. In our opinion the main reason for failure to maintain the neck-shaft angle is the degree of bone comminution and instability of the fracture.

Dhal *et al.* also reported limb shortening of 2 cm or greater than 2 cm in 53.8% of patients. It was caused either by fixation in varus or by collapse of the neck-shaft angle. Only three (17.6%) of our patients had limb shortening, which was less than 2 cm in all three. These patients had an imperfect reduction of their fractures due to multiple life-threatening injuries to abdominal viscera or the thoracic wall.

Our experience with pin-site care showed that skin dressing once a week was quite sufficient. Skin care was difficult to maintain in obese patients. Deep pin tract infection occurred in one extremely obese patient, and the fixator had to be removed. Chronic osteitis with a fistula developed in two of our patients. The main cause was considered to be the long delay from injury to reduction and fixation of their fractures in our hospital.

Hip and knee stiffness was probably the result of the long period of immobilization. Nevertheless, our patients were satisfied with the outcome of treatment, and limitation of hip and knee movement did not restrict their daily activities. The limitation in hip and knee motion may be an acceptable price to pay, given the difficulty in treating such fractures.

## CONCLUSION

Pelvifemoral external fixation devices make nursing care much easier, provide stable bone fixation and allow early patient mobilization. It is obvious that this technique has some specific advantages: versatility in stabilization of this type of fracture, application of the device with minimal operative trauma and maintenance of access to the wound. This surgical treatment is the optimal method in cases of compound fractures of the

proximal third of the femur with extensive soft tissue damage caused by firearms.

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### SAMENVATTING

*D.M. MIRIC, M. Z. BUMBASIREVIC, K. K. SENOHRADSKI, Z. P. DJORDJEVIC. Pelvifemorale uitwendige fixatie bij open proximale dijbeen breuken door vuurwapens.*

Het artikel beschrijft de behandeling met pelvifemorale uitwendige fixatie en het verloop bij zeventien patienten, die een open graad III proximale femurfractuur hadden opgelopen veroorzaakt door oorlogsprojectielen en ontploffingen. Er was telkens massieve vreemd lichaam contaminatie.

Bij vijf patienten was er een n.ischiadicusletsel (29,4%), en abdominale en thoracale letsels waren aanwezig bij twee (11,8%). Er waren geen majeure vaatletsels.

Volledige steunname werd toegelaten na klinische en radiologische bevestiging van fractuurheling (gemid-

delde duur : 11,5 maanden). Er trad chronische osteïtis met fistulisatie en sekwestervorming op in twee gevallen (11,8%).

Geen enkel geval leidde tot pseudarthrosis of re-fractuur. Bij allen bleef een zekere heupstijfheid zonder pijn over. Open fracturen van het proximale derde van het femur door vuurwapens vormen een aparte groep binnen de open fracturen: gewoonlijk Ajn ze communiteef, een stabiele lokale externe fixatie is moeilijk of onmogefijk te realiseren, en bij intramedullaire fixatie is het risico voor infectie te hoog.

Pelvifemorale uitwendige fixatie laat een adekwate verzorging van de weekdelen toe, stabiliseert de fractuurelementen bevredigend en staat vrij snelle mobilisatie van de patient niet in de weg.

### RESUME

*D. M. MIRIC, M. Z. BUMBASIREVIC, K. K. SENOHRADSKI, Z. P. DJORDJEVIC. La fixation externe pelvi-fémorale dans le traitement des fractures ouvertes par armes à feu du fémur proximal.*

Les auteurs ont traité par fixation externe pelvi-fémorale 17 patients qui présentaient une fracture ouverte du tiers supérieur du fémur. Il s'agissait dans tous les cas de fractures ouvertes de grade III, résultant de traumatismes par projectiles à haute vélocité ou par explosion, avec contamination massive par des corps étrangers. Une lésion du nerf sciatique était présente dans 5 cas (29,4%) ; des lésions des viscères abdominaux et de la paroi thoracique étaient présentes chez deux patients (11,8%). Il n'y avait aucune lésion artérielle grave.

La remise en charge complète a été autorisée après consolidation clinique et radiologique, en moyenne à 11,5 mois. Deux patients ont présenté une ostéite chronique avec fistulisation et séquestre. Il n'y a eu aucune pseudarthrose ni aucune refracture. Tous les patients conservaient une limitation légère de la mobilité de la hanche, sans douleur associée.

Les fractures ouvertes du tiers supérieur du fémur par armes à feu représentent un type particulier de fractures ouvertes. Elles sont d'ordinaire très comminutives ; il est donc difficile voire impossible d'en assurer une fixation stable au moyen d'un fixateur externe dont les broches transfixent le foyer de fracture. D'autre part, un enclouage médullaire exposerait à un risque élevé d'infection. La fixation externe pelvi-fémorale permet un traitement adéquat des lésions des tissus mous, assure une fixation osseuse stable et permet de mobiliser précocement les patients.