



External fixation of femoral fractures in multiply injured intensive care unit patients

Konstantinos J. KAZAKOS, Dionisios J. VERETTAS, Konstantinos TILKERIDIS, Vasilios G. GALANIS,
Konstantinos C. XARCHAS, Alexandra DIMITRAKOPOULOU

From Democritous University of Thrace Medical School, Alexandroupolis, Greece

We report the results of a prospective study of 42 patients with multiple injuries, including femoral fractures, who required intensive care unit (ICU) admission and whose fractures were treated by means of external fixation. The Injury Severity Score (ISS) ranged from 18 to 41 and the average Glasgow Coma Scale (GCS) on admission was 12. Seventeen fractures were open. All patients had their fractures stabilised within 6 hours from admission by means of external fixation. After a follow-up of 11 months (range 4-20), 28 fractures had healed within 6 months (range 4.5-8) and 13 developed non-union which was treated successfully with secondary intramedullary nailing. One patient developed deep infection following secondary nailing and another patient died from adult respiratory distress syndrome (ARDS). We conclude that external fixation of severe femoral fractures in critically ill patients is an easy and quick method of stabilisation which does not compromise their condition. If however it is intended to be used as a final method, these patients require a close follow-up since the rate of delayed and non-union is high.

Keywords : femoral fracture ; external fixation ; multiple injuries ; intensive care.

INTRODUCTION

It is well accepted that early stabilisation of femoral fractures by means of intramedullary nailing should be achieved in order to avoid pulmonary

complications (pneumonia, adult respiratory distress syndrome, fat embolism syndrome and pulmonary embolus) (4, 5, 23) but controversy exists regarding the method of stabilisation of these fractures in multiply injured patients with co-existing severe pulmonary or head injuries. Unreamed intramedullary nailing and plating have been proposed as alternative methods for these patients, despite the fact that both can destabilise these patients' borderline condition. The aim of this study is to report the results achieved in 42 multiply injured patients with femoral fractures which were treated with external fixation and, considering the complications noted with this method of treatment, to determine whether it can provide an effective alternative for this type of patients.

-
- Konstantinos J. Kazakos, MD, PhD, Assistant Professor.
 - Dionisios J. Verettas, MD, PhD, Associate Professor.
 - Konstantinos Tilkeridis, MD, Orthopaedic Surgeon.
 - Vasilios G. Galanis, MD, Orthopaedic Surgeon.
 - Konstantinos C. Xarchas, MD, PhD, Assistant Professor.
 - Alexandra Dimitracopoulou, MD, Orthopaedic Surgeon.

Department of Orthopaedics, Democritous University of Thrace Medical School, 68100 Alexandroupolis, Greece.

Correspondence : Konstantinos C. Xarchas, Smirnis 3-5, N. Hili, Alexandroupolis, 68100, Greece.

E-mail : drkcxr@yahoo.com.

© 2006, Acta Orthopædica Belgica.

Table I. — Type of coexisting chest injury in patients with thorax AIS > or = 2

Type of injury	Number of patient (n)	Percentage (%)
Rib fractures > 2	17	60.7
Unilateral	12	42.8
Bilateral	5	17.8
Flail chest	2	7.14
Pulmonary contusion	15	53.6
Unilateral	9	32.1
Bilateral	6	21.4
Hemothorax	6	21.4
Unilateral	6	21.4
Bilateral	—	—
Pneumothorax	19	67.8
Unilateral	17	60.7
Bilateral	2	7.14
TOTAL	28	100

MATERIAL AND METHODS

Forty two multiply injured patients with femoral fractures were treated in the intensive care unit (ICU) of our institution during the period 1995-1999. Twenty five of them had closed fractures and 17 open fractures, of which 3 were Type II, 9 Type IIIA and 5 Type IIIB according to the Gustilo and Anderson classification (8, 9). Twenty eight were men and 14 women and their ages ranged from 23 to 61 years (mean age : 30 years). Their Injury Severity Score (ISS) (2) ranged from 18 to 41 (average 32). All patients on admission were haemodynamically unstable. Sixteen had suffered serious head injury with, on admission, an average score equal or superior to 2 in the Abbreviated Injury Scale (AIS) (6), and a Glasgow Coma Scale (GCS) score of 8 (average 6-11). The rest of the patients had a GCS score of 13.1 (range 10-14). Twenty eight patients suffered from serious chest injury (table I) with an AIS equal or superior to 2, seven from abdominal injuries and 18 from additional musculoskeletal injuries.

In all patients the fractures were stabilised with external fixation within 6 hours from admission, under general anaesthesia, after initial meticulous wound toilet and debridement of all open fractures. In all patients the uniplanar STAR 90 external fixator was used, the operating time for its application averaged 30 minutes and the blood loss was minimal (average 60 ml). Adequate closed reduction was confirmed by image intensifier in all cases. If the fracture could not be reduced in an acceptable position by closed means, it was stabilised in

its present position and the fixator exchanged for an intramedullary nail when the patients' condition allowed. This group included 11 patients. For obvious reasons, these patients were excluded from the study, as it was decided from the very beginning that the treatment method was to be changed. Post-operatively all patients returned to the ICU until their general condition permitted their transfer to the orthopaedic department. As soon as their general condition allowed it, the patients and family were informed about the pros and cons of continuation of their treatment by means of external fixation. They all consented, mostly on the grounds of avoiding a second operation, accepting the possibility that such an operation might be necessary in the future. Maintenance of reduction and healing progress were followed by AP and lateral radiographs which were taken every two weeks for the first two months, then monthly until at least the ninth postoperative month.

RESULTS

The patients remained in the ICU for an average of 12 days (range, 6-19 days) and the average hospitalisation time was 24 days (range, 12-31 days). One patient died from adult respiratory distress syndrome on the sixth postoperative day. In two cases reduction was lost during the second and third postoperative week, requiring re-manipulation. One of these two went on to non-union.

After a follow-up period which averaged 9 months (range, 4-20 months), 28 fractures had united within 6 months, while 13 developed non-union (31%). The fractures that developed non-union were treated successfully by removing the external fixator and converting to reamed intramedullary nailing. The time interval between the removal of the fixator and the intramedullary nailing was usually 2 weeks, provided that signs of local inflammation were absent, ESR was below 20 mm/1 hour and CRP values were normal. If pin tract infection had been present, the time interval was increased until repeated pin tract cultures were negative, in addition to ESR and CRP measurements. Despite these precautions one patient developed a *Staphylococcus Aureus* deep infection and required an exchange reaming and nailing procedure with irrigation and prolonged parenteral antibiotic

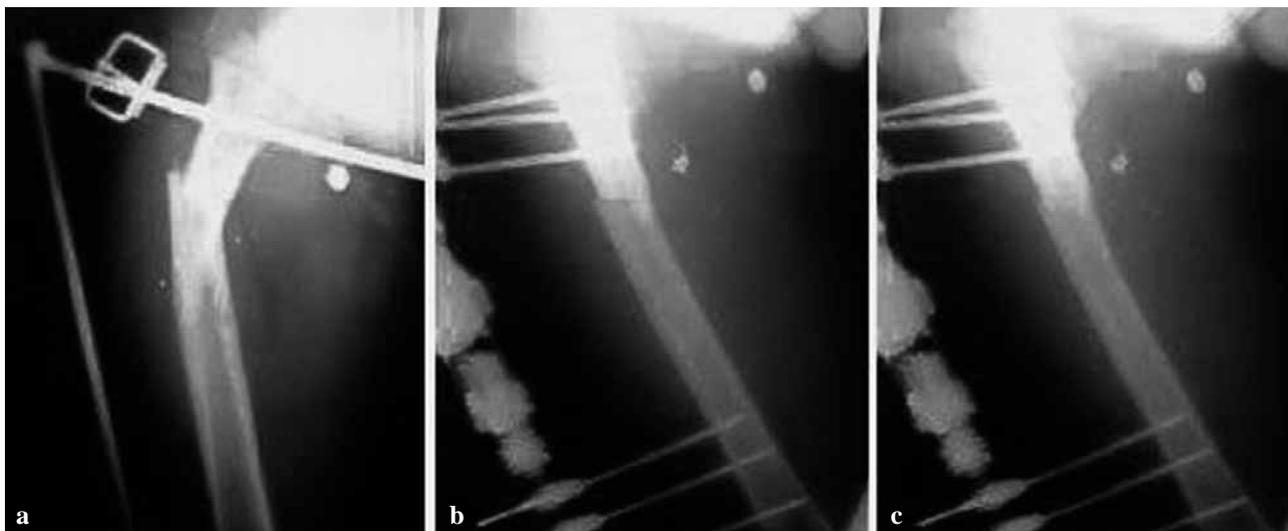


Fig. 1. — **a.** A 41-year-old man who sustained a type IIIA open fracture of the right femur from a gunshot, with a concomitant head injury and a GCS score of 8 ; **b.** *In situ* stabilisation with external fixation within 6 hours ; **c.** The patient developed a *Staphylococcus aureus* deep infection and underwent an exchange reaming and nailing procedure with irrigation and long parenteral antibiotic treatment.

treatment. The fracture proceeded to union with no further complications (fig 1).

Sixteen patients (38%) developed severe knee stiffness (range of flexion 5-60°). The range of movement improved with physiotherapy after removal of the fixator but seven knees had to be manipulated under anaesthesia.

Thirty four patients developed minor pin tract infection which settled promptly with wound toilet and oral antibiotics. In four patients, pins had to be removed because of loosening and were repositioned in new sites.

DISCUSSION

Early stabilisation of femoral fractures is preferable, as increased pulmonary complications, including acute respiratory failure, fat embolism and pneumonia have been reported following delayed fracture treatment (3, 17, 22), while conversely no increase has been reported in the prevalence of CNS complications following fracture stabilisation (23). On the other hand, Rogers *et al* (18) advocated that stabilisation of isolated femoral fractures can be delayed for up to 72 hours without increasing the risk of complications, since urgent

fracture fixation resulted into a larger number of emergency operations, longer time of surgery and was considered to be an unwise use of resources.

The treatment of multiply injured patients with fractures of the long bones and additional head and chest injuries can be controversial and should be approached with a variety of treatment options. Townsend *et al* (25) and Jaicks *et al* (11) noticed poorer CNS outcomes more frequently after early fracture fixation and recommended 24 hours delay in order to prevent hypoxia, hypotension and low cerebral perfusion pressure. On the other hand Scalea *et al* (20) found no difference in the GCS scores upon discharge, of patients with closed head injuries who underwent either early or delayed fracture fixation.

Early femoral fracture fixation with reamed intramedullary nails is a matter of controversy in the presence of severe chest injuries with pulmonary compromise. Pape *et al* (14) showed that early reamed intramedullary nailing of femoral fractures in patients with chest trauma resulted into a higher incidence of post-traumatic ARDS and recommended the use of unreamed nails (15, 16). However other reports (10, 24) have shown that unreamed IN could similarly cause chest embolisa-

tion with bone marrow content, with the addition of poorer results in fracture healing.

External fixation as an early method of femoral fracture stabilisation is attractive, especially for multiply injured patients who require ICU treatment for their head and chest injuries. Many authors have shown good outcome of fracture healing after early exchange of the external fixation with reamed intramedullary nailing (IN) (13, 21). Provided the exchange was performed soon after the application of the EF, no serious complications were reported and the rate of fracture union was found to be no different from that following primary IN. The use of external fixation as a final method of treatment for this particular group of patients has attracted little interest, despite its obvious advantages of not further destabilising a patient that had recently been or still was critically ill. In isolated femoral fractures, external fixation has been found to be an unsatisfactory method due to an increased rate of delayed and non-union and complications from the soft tissues (1, 7, 12, 19).

We opted for the use of EF for femoral fractures in multiply injured ICU patients as a final method of treatment in circumstances where either the general condition of the patient was so unstable as to forbid major bony procedures, or the femoral fracture was open. As a result of the short operative time and the minimal blood loss, none of our patients showed any deterioration of brain function postoperatively, and none developed intraoperative hypotension or hypoxia. We considered a conversion to IN only when the fracture showed signs of delayed union or malunion.

Our results showed that the rate of non-union was high compared to primary nailing or plating, but not as high compared to EF of isolated femoral fractures treated by external fixation.

Furthermore knee stiffness was high, although improvement in the range of motion was noted, after removal of the fixator.

In conclusion we believe that external fixation as a definitive method of treatment should not be the choice for any femoral fracture, but offers a useful alternative in heavily injured patients, whose critical condition does not allow major surgical interventions for a long period of time.

On the contrary, the value of early stabilisation of femoral fractures by means of external fixation in cases of polytrauma is undisputable and life saving as shown in our series and others' series. Early conversion to an intramedullary nail is advisable.

REFERENCES

1. **Alonso J, Geissler W, Hughes, JL.** External fixation of femoral fractures. Indications and limitations. *Clin Orthop* 1989 ; 241 : 83-88.
2. **Baker SP, O'Neil B, Haddon W Jr, Long WB.** The Injury Severity Score : A method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974 ; 14 : 187-196.
3. **Bone LB, Johnson KD, Weigelt J, Scheinberg R.** Early versus delayed stabilization of femoral fractures. A prospective randomized study. *J Bone Joint Surg* 1989 ; 71-A : 336-340 .
4. **Brundage SI, McGhan R, Jurcovich GJ et al.** Timing of femur fracture fixation : effect on outcome in patients with thoracic and head injuries. *J Trauma* 2002 ; 52 : 229-307.
5. **Charash WE, Fabian TC, Croce MA.** Delayed surgical fixation of femur fractures is a risk factor for pulmonary failure independent of thoracic trauma. *J Trauma* 1994 ; 37 : 667-672.
6. **Committee on Medical Aspects of Automotive Safety.** Rating the severity of tissue damage : I. The abbreviated injury scale. *JAMA* 1971 ; 215 : 277.
7. **Dabezies EJ, D'Ambrosia R, Shoj H et al.** Fractures of the femoral shaft treated by external fixation with the Wagner device. *J Bone Joint Surg* 1984 ; 66-A : 360-364.
8. **Gustilo RB, Anderson JT.** Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones : Retrospective and prospective analyses. *J Bone Joint Surg* 1976 ; 58-A : 453-458.
9. **Gustilo RB, Mendoza RM, Williams DN.** Problems in the management of type III open fractures : a new classification of type III open fracture. *J Trauma* 1984 ; 24 : 742-746.
10. **Heim D, Regazzoni P, Tsakiris D et al.** Intramedullary nailing and pulmonary embolism : does unreamed nailing prevent embolization ? An in vivo study in rabbits. *J Trauma* 1995 ; 38 : 899-906.
11. **Jaicks RR, Cohn SM, Moller BA.** Early fracture fixation may be deleterious after head injury. *J Trauma* 1997 ; 42 : 1-6.
12. **Murphy DJ, D'Ambrosia RD, Dabezies EJ et al.** Complex femur fractures : treatment with the Wagner external fixation devise or the Gross-Kempf interlocking nail. *J Trauma* 1988 ; 28 : 1553-1561.
13. **Nowotarski PJ, Turen CH, Brumback RJ, Scarboro JM.** Conversion of external fixation to intramedullary nailing for fractures of the shaft of the

- femur in multiply injured patients. *J Bone Joint Surg* 2000 ; 82-A : 781-788.
14. **Pape HC, Regel G, Dwenger A et al.** Effekte unterschiedlicher intramedullärer Stabilisierungsverfahren des Femur auf die Lungenfunktion bei Polytrauma. *Unfallchirurg* 1992 ; 95 : 634-640.
 15. **Pape HC, Dwenger A, Regel G et al.** Pulmonary damage after intramedullary nailing in traumatized sheeps – Is there an effect from different nailing methods. *J Trauma* 1992 ; 33 : 574-640.
 16. **Pape HC, Aufm’Kolk M, Paffrath T et al.** Primary intramedullary femur fixation in multiple trauma patients with associated lung contusion-a cause of posttraumatic ARDS ? *J Trauma* 1993 ; 34 : 540-547.
 17. **Riska E, vonBonsdorff H, Hakkinen S et al.** Primary operative fixation of long bone fractures in patients with multiple injuries. *J Trauma* 1977 ; 17 : 111-121.
 18. **Rogers FB, Shackford SR, Vane DW et al.** Prompt fixation of isolated femur fractures in a rural trauma center : a study examining the timing of fixation and resource allocation. *J Trauma* 1994 ; 36 : 774-777.
 19. **Rooser B, Bengston S, Herrlin K, Onnerfalt R.** External fixation of femoral fractures : experience with 15 cases. *J Orthop Trauma* 1990 ; 4 : 70-74.
 20. **Scalea TM, Scott JD, Brumback RJ et al.** Early fracture fixation may be “just fine” after head injury : no difference in central nervous system outcomes. *J Trauma* 1999 ; 46 : 839-846.
 21. **Scalea TM, Boswell SA, Scott JD et al.** External fixation as a bridge to intramedullary nailing for patients with multiple injuries and with femur fractures : damage control orthopedics. *J Trauma* 2000 ; 48 : 613-621.
 22. **Seibel R, La Duca J, Hasset TM et al.** Blunt multiple trauma (ISS 36), femur traction, and the pulmonary failure septic state. *Ann Surg* 1985 ; 202 : 283-295
 23. **Starr AJ, Hunt JL, Chason DP et al.** Treatment of femur fracture with associated head injury. *J Orthop Trauma* 1998 ; 12 : 38-45.
 24. **Tornetta P IIIrd, Tiburzi D.** Reamed versus nonreamed anterograde femoral nailing. *J Orthop Trauma* 2000 ; 14 : 15-19.
 25. **Townsend RN, Lheureau T, Protech J et al.** Timing fracture repair in patients with severe brain injury (Glasgow Coma Scale score < 9). *J Trauma* 1998 ; 44 : 997-982.