



Original article

ACTA FAC MED NAISS 2007; 24 (1): 21-26

Predrag Stojiljkovic¹
 Zoran Golubovic¹
 Desimir Mladenovic¹, Ivan Micic¹
 Sasa Karalejic¹, Igor Kostic¹
 Slobodan Milenkovic²

¹Clinic of Orthopedics and
 Traumatology,
 Clinical Center Nis
²Orthopedic Department
 of the Health Centre Vranje

EXTERNAL FIXATION IN PRIMARY TREATMENT OF THE FEMORAL SHAFT FRACTURE

SUMMARY

External fixation has not been widely used for femoral shaft fractures. External fixation is generally reserved for severe open fractures and for initial stabilization of fractures in polytrauma patients.

From January 1, 2000 to December 31, 2005, 23 patients with 24 femoral shaft fractures were treated by external fixator Mitkovic. The series included 19 (83%) men and 4 (17%) women, mean age 35.9 years. All patients were victims of high-energy trauma: 16 (70%) traffic accidents, 3 (13%) falls from height and 4 (17%) firearm wounds. Fourteen (61%) patients had multiple injuries. One patient had bilateral femoral shaft fractures and three patients had another fracture in the lower extremity. Fourteen (58.3%) fractures were open. Sixteen fractures (66.6%) had comminution.

Twenty-one fractures (87.5%) healed without complication including five fractures where external fixation was converted into internal one. The mean time to union was 6.5 (4-9) months. There were two pin-track infections (8.3%), two deep infections (8.3%), and only one nonunion (4.1%). The femur length was equal to the healthy side in 19 cases, and was shorter by 1-2 cm in 5 cases. Mean active knee flexion was 90° (40-130°). Knee flexion was more than 110° in 9 (39.1%) patients.

External fixation by the use of Mitkovic external fixator is a useful technique for the stabilization of severe open and close highly comminuted femoral shaft fractures until union. It is also a safe procedure to achieve temporary rigid stabilization of femur fracture in too critical polytrauma patients before delayed internal fixation (damage control orthopedics).

Key words: femoral shaft fracture, external fixation, external fixator Mitkovic

INTRODUCTION

Femoral shaft fractures are most often encountered in younger people (1). They are usually caused by very strong direct or indirect force effect and are the consequence of traffic accidents, fall from height or firearm injuries (2). More and more intensive traumatic agents bring about more frequent comminuted and open femoral shaft fractures (3).

Femoral shaft fractures are often associated with other injuries within polytrauma followed by traumatic shock. The very femoral shaft fracture, due

to a great blood loss (up to 1.5 l), releasing of great amount of inflammatory mediators and strong pains, makes the polytrauma even harder (4).

External fixation has not been widely used for femoral shaft fractures and few series have been reported in the literature. External fixation is generally reserved for severe open fractures and for initial stabilization of fractures in polytrauma patients (5).

We present a retrospective analysis of a series of patients with femoral shaft fractures treated by Mitkovic external fixator in order to detail the

indications of this fixation technique.

MATERIAL AND METHODS

We analyzed a series of 23 injured persons who sustained femoral shaft fractures treated by external fixation method at the Clinic of Orthopedics and Traumatology, Clinical Center Nis in the period between January 1, 2000 and December 12, 2005. One of the patients had a bilateral femoral fracture treated by external fixation method. In all the patients we used a Mitkovic external fixator in the treatment of femoral fractures.

The Mitkovic external fixator consists of three simple components: bar, clamps' carrier and clamps. Its application is quick and simple. After placing the pins under various angles in relation to each other in the convergent orientation, the frame is applied, and a great mobility of the clamps and clamps' carrier structure makes the application very simple and quick. After the fracture reposition which can be performed by closed method (under the roentgen control) or open method (by incision over the fracture site) all the joints of the apparatus are locked.

In the series analyzed, the male sex was prevalent – there were 19 men (83%). The mean age was 35.9 years. The youngest patient was 18 years old, while the oldest patient was 68. The majority of patients were in the third and fourth decade of life.

The traffic traumatism was the cause of sustaining injuries in 16 patients (70%), fall from height in three patients (13%), while four patients (17%) sustained the firearm injuries.

Fourteen patients, besides the femoral shaft fractures, had the associated injuries of other body regions within polytrauma. Four patients had multiple fractures of long bones of the lower limbs.

In the group analyzed, there were 24 femoral fractures (Figure 1). There were 14 open fractures (58.3%). The classification of open fractures was done according to the Gustil classification.

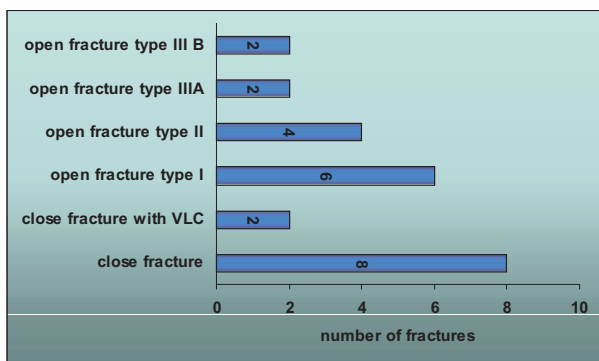


Figure 1 Type of femur shaft fracture treated by external fixation

The analyzed group comprised 16 (66.6%) comminuted femoral shaft fractures.

In the case of 19 femoral shaft fractures, external fixation was the definitive treatment method, while in five cases, we did conversion into internal fixation by self-dynamisable internal fixator Mitkovic after 21 days.

AT protection was administered to all the patients with open fractures. Also, they all received antibiotic therapy, depending on the kind of fracture and polytrauma. In the majority of patients, the low-molecular-weight heparin anti-coagulant therapy was administered (this kind of therapy was not administered in two polytrauma patients with profuse bleeding).

In the examinees, we analyzed: the time from sustaining an injury to the external fixation application, technique and duration of external fixation of femoral fracture, mean time of femoral fracture healing, scope of the knee movements, wounds and late complications associated with femoral fractures as well as common complications.

The examinees were followed one year postoperatively.

RESULTS

In the majority of patients – 19 of them (79.1%), external fixation of femoral shaft fracture was performed during the first twenty-four hours, while in five patients (20.9%) it was performed between the 2nd and 7th day (on average 3.1 days after sustaining an injury) (Figure 2).

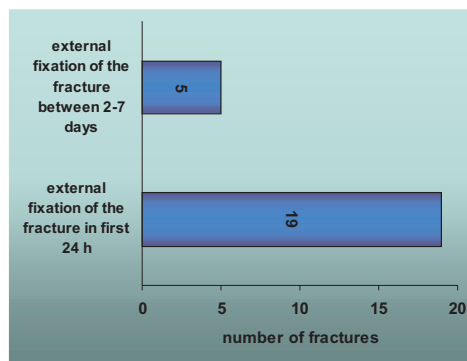


Figure 2 Time of external fixation of femur shaft fracture

Mean duration of external fixation of the femur was 34.8 min (25-40 min). The open and closed method of fracture reposition was applied in 15 and 9 fractures, respectively.

Union was attained in 21 fractures (87.5%) including five fractures in which the conversion into internal fixation was performed. Mean time of healing of femoral fractures treated by external

fixation was 6.5 months (4-9 months). In all five polytrauma patients with femoral fractures, in whom the conversion into internal fixation by Mitkovic self-dynamisable internal fixator was performed, the union was attained up to six months. There was no development of osteomyelitis in the patients in whom the conversion of external into internal fixation was performed.

Among common complications during hospitalization, there was only one case of deep venous thrombosis (4.3%).

Among local complications associated with femoral fractures, in two cases (8.3%) we registered pin-track infection; in two cases (8.3%) osteomyelitis development (open femoral shaft fractures with severe damages of soft tissues were present in both cases), and one case of fracture nonunion (4.1%).

The femur length was equal to the healthy side in 19 cases, and was shortened by 1-2 cm in five cases.

Mean active knee flexion was 90° (40-130°). Knee flexion was greater than 110° in nine (39.1%) patients.

CASE REPORT

A patient twenty-two years old sustained a gunshot injury to the right hip (open comminuted II degree femoral fracture without lesions of neurovascular elements). Soon after, the patient underwent the operation. The external fixation of femoral fracture was performed, as well as debridement of the entrance and exit wounds.



Figure 3. Open femoral shaft fracture treated by external fixation

The wounds on the limb healed per secundam. The postoperative finding was regular. The time of mobilization was seven days postopera-

tively. External fixation was the definitive treatment method. The fracture healed within seven months (Figure 4).



Figure 4. Time of healing of open femoral shaft fractures was 7 months

The functional result was excellent with the knee flexion over 110°.

DISCUSSION

External fixation is an expedient and minimally invasive method of long-bone fracture stabilization (5, 6). Unfortunately, definitive treatment of fractures of the femur with external fixation until union is associated with a high risk of several complications. Nonunion in up to 20 percent of patients, deep pin-track infection in up to 20 percent, and knee stiffness in up to 45 percent were all reported in a series of fractures of the femur treated with external fixation (7).

External fixation is generally reserved for severe open fractures, for stabilization of close comminuted femoral shaft fractures and for early fracture stabilization in multiply injured patients (8).

External skeletal fixation in the treatment of open femoral fractures (gradus II and III) is a method of choice because it stabilizes the fracture and allows any soft-tissue wounds to be treated daily, as necessary. In highly contaminated open fractures, external fixation is the method of choice, since the

risk of infection is great, so that internal fixation is not indicated (1). In those classes of open injuries, the soft-tissue damage is combined with comminution at the fracture site, segmental fractures or loss of bone (9). With external fixation, uninjured tissue planes are not opened and the periosteal circulation is not disturbed, as is the case with the use of most internal fixation devices (10). The medullary canal is not open and the endosteal circulation is not disrupted, so that there is minimum operative trauma. In limbs in which vascular repair is required, the external skeletal fixator is a good device to stabilize the fracture fragments (11). External fixation is a useful technique for the stabilization of close comminuted femoral shaft fractures where modern technology is not available. Pin-track infection and knee stiffness can be minimized with good pin hygiene and knee exercises (12).

In the series we presented, open fractures are prevalent. In the group of open fractures, the fractures of II, IIIa and IIIb degrees are dominant. Analyzing the kind of fracture, we ascertained that comminuted fractures were the most frequent. The most severe type of fracture in polytrauma patients was open comminuted fractures which occurred due to high-energy trauma, which is typical of traffic traumatism. The management of such fractures stands for a specific problem for increased risk of infections and other complications (delayed healing and development of pseudoarthrosis) (13).

There are many benefits of early fracture stabilization in multiply injured patients: the procedure facilitates patient's mobility, improves pulmonary toilet, decreases pain and thus the need for narcotics, decreases inflammatory mediator response, and decreases thromboembolic phenomena. Early stabilization of femoral fractures has been shown to decrease morbidity and mortality (14).

Based on the concepts of damage control surgery, the application of the same principles to the management of the multiply-injured patient with associated fractures of the long bones and pelvic fractures was named 'damage control orthopedics'. It also consists of three stages. The first involves an early temporary stabilization of unstable fractures and the control of hemorrhage and, if indicated, decompression of intracranial lesions. The second stage consists of resuscitation of the patient in the intensive-care unit and optimization of his condition. In the third stage, delayed definitive management of the fracture is undertaken when the patient's condition allows it. The favored technique for achieving temporary stability of the fractured pelvis or a fracture of a long bone is external fixation. This is an expedient and minimally invasive method and can be used very efficiently to accomplish the early

stabilization of the fracture and to control the additional biological stresses posed by prolonged surgical procedures. The delayed definitive procedure for the stabilization of fractures of long bones, in particular fracture of the femur, is usually intramedullary nailing and this is carried out when the condition of the patient is stable and optimized (7). Scalea et al. concluded that the external fixation was a safe procedure to achieve temporary rigid stabilization in patients with multiple injuries at risk of an adverse outcome (15). Nowotarski et al. also found that the approach using damage control orthopedics was also safe for managing fractures of the shaft of the femur in selected patients with multiple injuries. Rates of infection after conversion of external fixation of the femur to intramedullary nailing range between 1.7% and 3%, 29,30 and are similar to those for primary intramedullary nailing of the femur (16). These studies indicate that conversion of external fixation to intramedullary nailing can be performed safely within the first two weeks and has a very low infection rate.

Our study comprised 14 polytrauma patients. In five fractures, conversion into internal fixation by Mitkovic selfdynamisable internal fixator at day 21 was performed, while in 9 cases within polytrauma, external fixation was definitive treatment method. There was no infection in patients in whom conversion of external into internal fixation was performed.

Mean time of healing of femoral fractures treated by external fixation in our series was 6.29 months (4-9 months) and was attained in 21 (87.5%) cases. Mean time of healing of severe comminuted fractures treated by external fixation, according to the world literature data, is 6-7 months approximately, and is usually followed by great percent of complications (pin-track infection and contracture of the knee joint) (12, 17). In our series, the pin-track infection was registered in 12.5% of cases, fractures' nonunion in 4.1%, and osteomyelitis in 4.1%. All the complications were successfully resolved.

CONCLUSION

External fixation of femoral shaft fractures by Mitkovic external fixator provides prompt fracture stabilization and stands for a minimally additional operative trauma, accompanied by minimal loss of blood. The very operative method is easy to perform and relatively simple since every pin can be set independently in any position and without a guider. It also gives a good insight into the state of soft tissues of an injured limb, thus providing the proper wound treatment of open femoral fractures, early mobility and easier treatment of the injured.

The external fixation method by Mitkovic external fixator is successfully used in the management of femoral fractures in polytrauma patients as a temporary method within the “damage control”

strategy, with the following conversion into internal fixation, and quite often as a definitive treatment method in open and severely comminuted closed femoral fractures.

REFERENCES

1. Banovic D. Nacela lecenja politraume. U: Banovic D. (ed). Traumatologija kostano-zglobnog sistema. Zavod za udzbenike i nastavna sredstva Beograd, 1998: 39-46.
2. Lawrence B. Manegment of polytrauma. In: Champan MW (ed). Operative Orthopaedics. JB Lippincott Company Philadelphia, 1993: 299-304.
3. Jurkovich JG, Carrico CJ. Trauma-Management of Acutely Injured Patients. In: Sabiston D. (ed). Textbook of surgery: The Biological basis of modern surgical practice-fifteenth edition. W.B. Saunders Company, 1997: 296-340.
4. Bose D, Tejwani NC. Evolving trends in the care of polytrauma patients. *Injury* 2006; 37(1): 20-8.
5. Mitkovic M. Spoljna fiksacija u traumatologiji. Prosveta Nis, 1992: 93-96.
6. Mitkovic M, Bumbasirevic M, Golubovic Z, Micic I, Mladenovic D, Milenkovic S, Lesic A, Bumbasirevic V, Pavlovic P, Karalejic S, Kuljanin G, Petkovic D. New concept in external fixation. *Acta Chir Jugosl* 2005; 52(2): 107-11.
7. Giannoudis PV. Surgical priorities in damage control in polytrauma. *J Bone Joint Surg Br* 2003; 85(4): 478-83.
8. Hildebrand F, Giannoudis P, Krettek C, Pape HC. Damage control: extremities. *Injury* 2004; 35(7): 678-89.
9. Tejan J, Lindsey RW. Management of civilian gunshot injuries of the femur. A review of the literature. *Injury* 1998; 29 Suppl 1: SA18-22.
10. Sabharwal S, Kishan S, Behrens F. Principles of external fixation of the femur. *Am J Orthop* 2005; 34(5): 218-23.
11. Dabezies EJ, D'Ambrosia R, Shohji H, Norris R, Murphy G. Fractures of the femoral shaft treated by external fixation with the Wagner device. *J. Bone Joint Surg Am* 1984; 66: 360-64.
12. Babar IU. External fixation in close comminuted femoral shaft fractures in adults. *J Coll Physicians Pak* 2004 Sep; 14(9); 533-5.
13. Della Rocca GJ, Crist BD. External fixation versus conversion to intramedullary nailing for definitive management of closed fractures of the femoral and tibial shaft. *J Am Acad Orthop Surg* 2006; 14(10): S131-5.
14. Pape HC, Hildebrand F, Pertschy S, Zelle B, Garapati R, Grimme K, Krettek C, Reed RL 2nd. Changes in the management of femoral shaft fractures in polytrauma patients: from early total care to damage control orthopedic surgery. *J Trauma* 2002; 53(3): 452-61.
15. Scalea TM, Boswell SA, Scott JD. External fixation as a bridge to intramedullary nailing for patients with multiple injuries and with femur fracture: damage control orthopaedics. *J Trauma* 2000; 48: 613-23.
16. Nowotarski PJ, Turen CH, Brumback RJ, Scarborough JM. Conversion of external fixation to intramedullary nailing for fracture of the shaft of the femur in multiply injured patients. *J Bone Joint Surg Am* 2000; 82-A: 781-8.
17. Bonneville P, Manset P, Cariven P, Bonneville N, Avel J, Mansat M. Single-plane external fixation of fresh fractures of the femur: critical analysis of 53 cases. *Rev Chir Otrhop Reparatrice Appar Mot* 2005; 91(5): 446-56.

SPOLJNA FIKSACIJA U PRIMARNOM LEČENJU PRELOMA DIJAFIZE FEMURA

Predrag Stojiljković¹, Zoran Golubović¹, Desimir Mladenović¹, Ivan Micic¹,
Saša Karalejić¹, Igor Kostić¹, Slobodan Milenković²

¹ Ortopedsko-traumatološka klinika, Klinički centar Niš

² Ortopedsko odeljenje, Zdravstveni centar Vranje

SAŽETAK

Spoljna fiksacija dijafize femura u savremenoj traumatologiji ima ograničenu primenu i uglavnom je rezervisana za teške otvorene prelome dijafize femura i za zbrinjavanje preloma dijafize femura kod politraumatizovanih.

Analizirana je serija od 24 preloma femura kod 23 bolesnika sa prelomom dijafize femura lečenih metodom spoljne fiksacije spoljnim fiksatorom Mitković u Ortopedsko-traumatološkoj klinici Kliničkog centra u Nišu, u periodu od 01.01.2000. do 31.12.2005. godine. Prosečna starost povređenih iznosi 35,9 godina.

Najmlađi ispitanik imao je 18 godina, dok najstariji 68 godina. Saobraćajni traumatizam bio je uzrok povređivanja kod 16 (70%) ispitanika, pad sa visine kod 3 (13%) ispitanika i ranjavanje iz vatrenog oružja kod 4 (17%) ispitanika. Bilo je 14 (58.3%) otvorenih preloma. U analiziranoj grupi bilo je 16 (66,6%) kominutivnih preloma dijafize femura.

Zarastanje je postignuto kod 19 (79,16%) preloma, uključujući i 6 preloma kod kojih je urađena konverzija u unutrašnju fiksaciju. Prosečno vreme zarastanja preloma dijafize femura, lečenih spoljnim fiksatorom, u našoj seriji, iznosilo je 6,5 meseci (4-9 meseci). Od lokalnih komplikacija u vezi sa prelomom femura, registrovali smo u 2 slučaja (8.3%) infekciju oko klinova spoljnog fiksatora, 2 slučaja (8.3%) razvoja osteomijelita (u oba slučaja radilo se o otvorenim prelomima dijafize femura sa teškim oštećenjem mekih tkiva) i jedan slučaj nezarastanja preloma (4.1%).

U 19 slučajeva nismo imali skraćenje femura, dok je u 5 ono iznosilo 1-2 cm.

Prosečna fleksija u kolenu iznosila je 90 stepeni (40-130 stepeni). Kod 9 bolesnika (39.1%) fleksija u kolenu bila je veća od 110 stepeni.

Metoda spoljne fiksacije aparatom za spoljnu fiksaciju Mitković uspešno se može koristiti u zbrinjavanju preloma femura kod politraumatizovanih kao privremena metoda u sklopu strategije "kontrola štete" uz kasniju konverziju u unutrašnju a često i kao definitivna metoda lečenja kod otvorenih i teških kominutivnih preloma dijafize femura.

Ključne reči: prelom dijafize femura, spoljna fiksacija, spoljni fiksator Mitković