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# COMPARATIVE ANALYSYS OF OPEN AND CLOSED METHOD OF EXTERNAL FIXATION IN THE TREATMENT OF CLOSED FRACTURES OF TIBIAL DIAPHYSIS

## SUMMARY

**The tibial diaphysis fractures rank among the commonest fractures of long bones encountered in orthopedic practice. Making of the right indication for the proper treatment is one of the most crucial moments in the treatment process.**

**The prospective analysis involved 30 patients with closed tibial diaphysis fractures treated by the external fixation method in the period from January 1, 2000 – December 31, 2004 in the Orthopedic – Traumatologic Department of the Health Care Center Cuprija and the Clinic of Orthopedics and Traumatology of the Clinical Center Nis. In half of the patients – 15, the closed method of external fixation was applied, while in the other half – 15 patients, we used the open method of external fixation. In the treatment of all patients, a Mitkovic external fixator with convergent pins' orientation was used.**

**By the analysis of the obtained results, it was ascertained that the fracture healing attained with the application of this method occurred in 28 patients (95.7%). The time interval during which the tibial diaphysis fracture healed was 3.5-5.5 months. In 2 patients (6.6%), one from each group, aseptic pseudoarthrosis developed. The examinees suffering from pseudoarthrosis were treated by Mitkovic CD apparatus and spongioplastics, after which good final results were obtained. Postoperative osteitis, as the most severe complication in the management of closed tibial diaphysis fractures, was not registered in any of the patients.**

**In the management of tibial diaphysis fractures, external fixation with the Mitkovic external fixator provides good biochemical conditions for the fracture healing.**

*Key words:* **closed tibial diaphysis fractures, external fixation, Mitkovic external fixator**

## INTRODUCTION

The fracture of tibial diaphysis ranks as one of the commonest diaphyseal fractures of long bones. It occurs as a consequence of a direct or indirect force effect. Nowadays, there are more and more unstable closed tibial diaphysis fractures which have occurred under the effect of a strong trauma and which are followed by soft tissues' damages, great comminution and fragments' dislocation (1). The operative treatment of unstable closed tibial diaphysis fractures usually ends up with healing without consequences in the sense of work incapacity or remaining deformity. The recent literature data have pointed to new possibilities in the treatment of unstable closed tibial diaphysis fractures by the method of external

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fixation (2). The efficacy particularly reflects in shortening of hospitalization time, prevention of the knee and joint contractures, fast activation of patients, healing of fractures and returning to everyday life and work activities.

External fixation is therapeutic, orthopedic-traumatologic method of fixation of fractured bones by means of pins and wires that pass through parts of the skeleton and outside are attached to the apparatus – the external fixator. In that way, the site of fracture stays without any foreign bodies, and bone vascularization is maximally preserved, both periosteal and intramedullary, which provides optimal biological conditions for fracture healing (3,4). Thus, the conditions for the infection development after the application of the external fixation method are minimal. In the surgical management, we can equally use either open or closed method of reposition and external fixation.

The aim of the paper is to present and compare the results of closed tibial diaphysis fractures by means of the open and closed method of reposition and external fixation applied at the Orthopedic-Traumatologic Department of the Health Care Center Cuprija and Clinic of Orthopedics and Traumatology of the Clinical Center Nis.

## MATERIAL AND METHODS

The prospective clinical study comprised a cohort of 30 patients with the tibial fractures surgically treated at the Orthopedic-Traumatologic Department of the Health Care Center Cuprija and Clinic of Orthopedics and Traumatology of the Clinical Center Nis in the period from January 1, 2000 to December 31, 2004.

The examinees were divided into two groups. The first group included 15 examinees in whom the tibial fractures were resolved by the open method of reposition and fixation of the tibial fracture by Mitkovic external fixator. The second group also comprised 15 examinees with the tibial fracture in the treatment of which the closed method of reposition and external fixation with the same type of external fixator were applied *(Figure 1)*. All the examinees had closed fractures. In the first group, external fixation was carried out by the open method, short incision at the fracture level along the front tibial edge (mean length 5-8 cm), with minimal moving of the soft tissue without deperiostation. In the second group of patients, the fracture external fixation was carried out by the closed method without opening of the fracture site. The check-up of the fractured fragments' reposition was done by fluoroscopy with the use of image intensifiers.

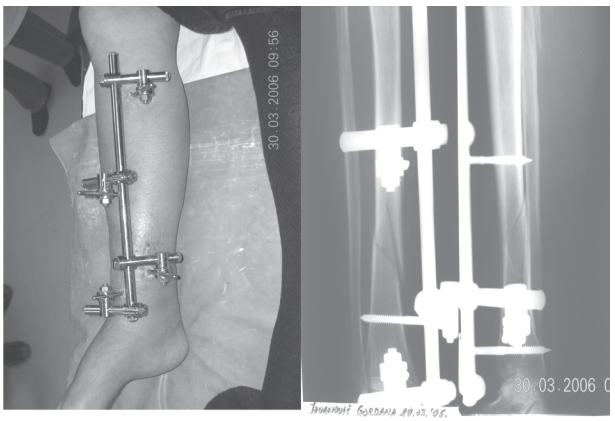


*Figure 1. Tibial diaphysis fracture treated by closed method of external fixation*

In the study analyzed, the male patients were prevalent. There were 24 men (80%) and 6 women (20%). The mean age of patients was 42.57 years. The youngest examinee was 18 years old, while the oldest patient was 76. The majority of patients were in the fifth decade of life – 8 patients (26.6%), 7 patients were in the fourth decade (23.3%), and 5 patients (16.6%) were in the sixth decade of life. The time from the admission to the operative treatment in the group of examinees treated by the open method of external fixation was 3.4±2.8 days, while in the group of patients treated by the closed method of external fixation, the mean time was 1.6±1.3 days.

In both groups of patients, we closely analyzed their medical documentation (history of disease, operative and anesthesiological protocols), and the examinees were followed one year after the fracture in ambulatory control protocols. We analyzed: duration of the operation, application of antibiotic therapy, duration of hospitalization, duration of wearing the external fixator, duration of the fracture healing and the treatment complications.

## RESULTS

In the group of patients treated by the open method of external fixation, there were 6 (20%) oblique, 3 (10%) spiral and 6 (20%) comminuted tibial fractures, while in the group of examinees treated by the closed method of external fixation, there were 4 (15%) oblique fractures, 2 (6%) spiral, 8 (26%) comminuted and 1 (3%) segmental fractures *(Table 1)*.

*Table 1. Types of fractures in the groups analyzed*

| type of fracture<br>method of reposition | oblique fracture | spiral fracture | comminuted fracture | segmental fracture | total |
|---|---|---|---|---|---|
| open method of reposition | 6 (20%) | 3 (10%) | 6 (20%) | 0 | 15 (50%) |
| closed method of reposition | 4 (15%) | 2 (6%) | 8 (26%) | 1 (3%) | 15 (50%) |
| total | 10 (35%) | 5 (16%) | 14 (46%) | 1 (3%) | 30 (100%) |

In the group of patients treated by the open method of external fixation of the tibial diaphysis fracture, there were no registered cases of transversal fractures, while oblique, spiral and comminuted fractures were equally present, without statistically significant difference in the patients examined. In the group of patients treated by the closed method of external fixation, segmental fractures were rarest, found only in 1 patient (3%). Spiral and oblique fractures were of similar frequency. The Hi square test showed that comminuted fractures were the most frequent compared to other types of fractures ($p<0.05$).

Duration of the operation by means of the open method of reposition and application of Mitkovic external fixator was on average 40.8±5.3 min, whereupon the t-test showed that the treatment duration of comminuted fractures (43.5±3.3) was significantly longer compared to oblique and spiral fractures ($p<0.01$) *(Figure 2)*. Duration of the operation by the closed method of reposition and application of Mitkovic external fixator was on average 31.1±9.2 min, and the t-test did not show any significant difference in the treatment duration with regard to the fracture type.

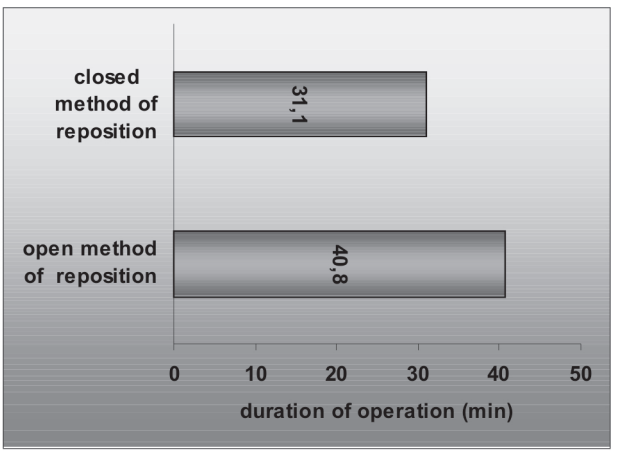


*Figure 2. Duration of operative treatment*

Duration of the antibiotic therapy application in the operative treatment by the open method of reposition and application of Mitkovic external fixator was on average 7.4±2.3 days in all kinds of fractures. Duration of the antibiotic therapy in the operative treatment by the closed method of reposition was on average 4.2± 2.1 days *(Figure 3)*.

The average number of hospital days in the group of patients treated by the open method of reposition and by Mitkovic external fixator application was 15.8±3.1 days *(Figure 4)*. Duration of intrahospital recovery was similar in both spiral and comminuted fractures. However, the t-test showed that comminuted fractures were characterized by greater number of hospital days compared to oblique fractures ($p<0.05$). The average number of hospital days after the operative treatment by closed method of reposition and Mitkovic external fixator application was 7.3±4.7 days.

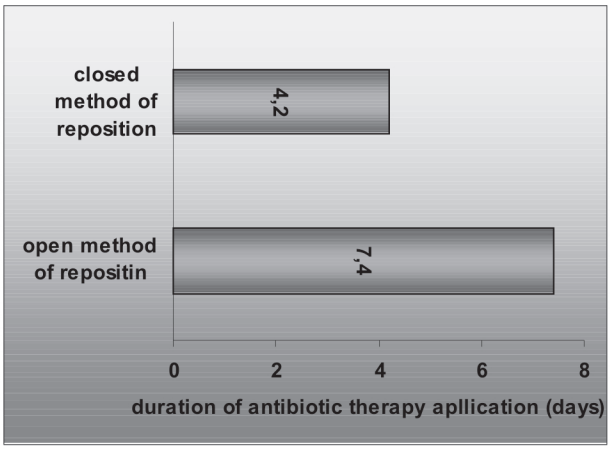


*Figure 3. Duration of antibiotic therapy application (days)*

Duration of intrahospital recovery was similar in both spiral and comminuted fractures, while the t-test showed that spiral and comminuted fractures were characterized by considerably greater number of hospital days compared to oblique fractures ($p<0.01$) *(Figure 4)*.

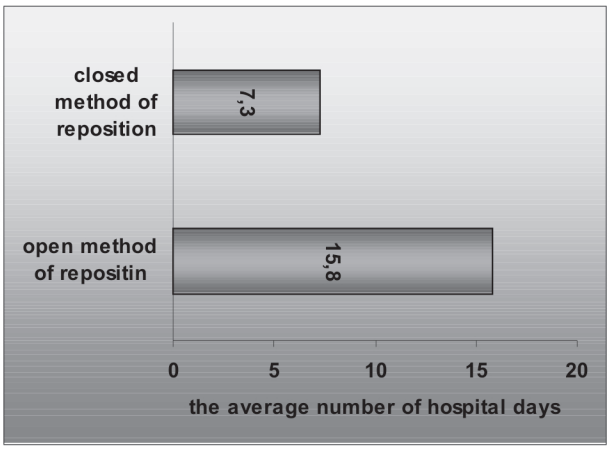


*Figure 4. Average number of hospital days*

Wearing the fixator after the intervention was on average similar regardless of the external fixation method and fracture type and was in duration of 5±1.87 months. In 28 patients, we registered the fracture consolidation (proper bone healing) in the interval from 15.2 – 20.5 weeks (3.5-5.5 months). In 2 patients (6.6%), one from each group, aseptic pseudoarthrosis developed. The examinees with pseudoarthrosis were treated by Mitkovic CD apparatus and spongioplastics, after which the final results were satisfactory. In 2 patients (6.6%), one from each group, there was a pin-track infection. After everyday dressing and antibiotic therapy, the

infection subsided in one patient. In the second patient, due to the pin-track infection, the external fixator was removed before the end of the treatment with the functional cast immobilization by Sarmiento. In the group analyzed, postoperative osteitis was not registered in any of the patients.

## DISCUSSION

In both groups, the frequency of oblique and comminuted tibial fractures is higher compared to spiral ones. The greatest number of transversal fractures belongs to the group of closed tibial fractures treated conservatively by plaster cast immobilization after an adequate reposition. Because of the very nature of injury, transversal fractures are characterized by greater fracture surface, and therewith better conditions for conservative treatment by functional cast immobilization by Sarmiento and finally better restitution outcome of conservative treatment (5).

Butkovic analyzed 60 cases of tibial fractures treated by Hofman external fixator, with satisfactory functional results at the end of the treatment (6). Golubovic et al. pointed to good functional results at the end of the treatment of 70 patients with unstable tibial diaphysis fractures. In the analyzed group, we did not register any patient with chronic postoperative osteitis. In the group of 37 patients (44.2%) whose treatment started with some other method (usually plaster cast immobilization), and after secondary fracture dislocation, the treatment was continued by the method of external fixation. The mean time from sustaining an injury to the external fixator application in that group of patients was 17.2 days. In the group of patients in which the method of external fixator was applied at the beginning, the time from the admission to the operative treatment was 2.3 days on average (7).

Duration of the operative treatment was affected by numerous factors, among which the most important is the skill of a surgeon as well as a kind of fracture. The kind of fracture with the accompanying comminution also determined duration of the operative treatment. In the cases in which the fragments were big and could not fit into the fracture composition during reposition, an additional osteosynthesis with loose screws and Kirschner's needles was carried out in order to obtain greater weight-bearing surface, with as little fragments' deperiostation as possible. Prolonged time of the operative treatment is the consequence of an additional operative procedure with the aim of fixation loose bone fragments when necessary.

Antibiotic therapy was administered only because of the operative tibial treatment, external fixator application, accompanying skin injuries (excoriation and contusion) as well as the associated diseases, but more frequently due to tibial diaphysis fractures in which the open method of reposition and external fixation were applied. In these patients, the antibiotic therapy was being administered for three days.

The time of fixator wearing after the intervention was mainly similar regardless of the external fixator method and fracture type and was in duration of 5±1.87 months. In 28 patients (95, 7%), the fracture consolidation (proper bone healing) was registered in the interval from 15.2 to 20.5 weeks (3.5-5.5 months). In 2 patients, one from each group, aseptic pseudoarthrosis developed. The examinees with pseudoarthrosis were treated by Mitkovic CD apparatus and spongioplastics, which showed good final results. In 2 examinees (6.6%), one from each group, the pin-track infection developed. After everyday dressing and antibiotic therapy, the infection subsided in one patient. In the other patient, due to the pin-track infection, the external fixator was removed before the end of the treatment when the functional cast immobilization by Sarmiento was applied. In the analyzed group, postoperative osteitis was not registered in any of the patients.

Many authors point to the fact that early weight-bearing establishment after the external fixator application stimulates the fracture healing, which in the case of tibial fractures ranges from 4 -4.5 months (8,9).

Bratten et al. describe their experiences in the treatment of the tibial diaphysis fractures with the external fixator and present good results in the treatment of 94% of examinees in whom the fractures healed in the interval from 3.4-6.5 months (10).

The total number of hospital days was significantly greater in the patients treated by open method of external fixation compared to the patients treated by closed method ($p<0.001$).

The greatest number of patients was from rural settlements whose health centers do not provide ambulatory conditions as well as necessary rehabilitation outpatient departments, so that it was essential to educate them how to use crutches and how to treat the wound around the external fixator pins. The patients treated by the open method in the hospital conditions were kept until sutures' removal and wound healing and meanwhile were trained to walk alone and maintain the wound toilette.

In the analyzed group of patients with closed tibial diaphysis fractures treated by open and closed method of external fixation, not a single case with postoperative osteitis was registered, which coincides with the results of other authors (6,10,11).

## CONCLUSION

The dilemma whether to perform operative or inoperative treatment in traumas of bone-articular system is quite evident in the treatment of tibial diaphysis fractures. Making of the right indication for the proper treatment (inoperative or operative) is one of the most crucial moments in the process of management. The best results in the management of tibial fractures can be obtained only by critical application of both methods, with strict allowing for the indications for the operative and functional inoperative management. Numerous factors affect prognosis, the choice of method, the course, and the final outcome of management of tibial diaphysis fractures.

The mechanism of injury sustaining, kind and degree of soft tissues' damages, the size of comminution and dislocation belong to the group of the most important factors in the tibial diaphysis fractures influencing the final treatment outcome. Their proper estimation leads to the right treatment method with as little complications as possible and regaining of the full function of the extremity injured. The major factors of instability of the tibial fracture which usually require operative management are: soft tissues' damages, affecting of articular surfaces, comminution and dislocation of fragments.

The application of Mitkovic external fixator in the external fixation of tibial diaphysis fractures brings about excellent results in all kinds of closed fractures, since Mitkovic external fixator provides excellent biological conditions for the fracture healing. In the surgical approach, either the open or closed method of reposition and application of Mitkovic external fixator can be used with equal success in the management of closed tibial diaphysis fractures. In their studies, the authors present the 96% success in the management with open and closed method of reposition and application of Mitkovic external fixator, while osteitis as the most dangerous complication has not been verified yet.

## REFERENCES

1. Trafton PG.Closed unstable fractures of the tibia. Clin Orthop1988; 230:58-67.

2. Mitkovic M. Spoljna fiksacija u traumatologiji. Prosveta, Nis, 1992.

3. Jovanovic Z, Markovic Lj, Mircic M, Pejak V. Faktori relevantni za procenu stepena tezine preloma tibije i njihova klasifikacija.Vojnosanit Pregled 1991; 48(2): 142-45.

4. Muller M,Algower M, Schneider R, Willenegger H. Manual of Internal fixation. Springer-Verlag New York Berlin Heidelberg 1992.

5. Golubovic Z. Lecenje zatvorenih preloma potkolenice. Zaduzbina Andrejevic, Beograd, 1997.

6. Butkovic Prelomi potkolenice. U "Traumatologija kostano-zglobnog sistema " Ed. 507-534. Decje novine, Gornji Milanovac, 1998.

7. Golubovic Z, Mitkovic M, Stojiljkovic P et all. Lečenje zatvorenih preloma dijafize tibije spoljnim fiksatorom Mitkovic. Acta Fac Med Naiss 2002; 19(3-4):256-62.

8. Schmidt AH, Finkemeir CG, Tornetta P 3rd.Treatment of closed tibial fractures.Inst Course Lect 2003; 52: 607-22.

9. Schatzeker J, Tile M. The Rationale of Operative Fracture Care. Springer Verlag, Berlin Heidelberg 1987.

10. Bratten M, Helland P, Gronttvedt T, Aamodt A, Benum P, Molster A.External fixation versus locked intramedullary nailing in tibial shaft fractures a prospective, randomised study of 78 patients.Arch Orthop Trauma Surg 2005; 125(1):21-6.

11. Golubovic Z. Uporedni efekti spoljne i untrašnje fiksacije u nastajanju postoperativnih osteitisa i formiranju kalusa kod zatvorenih preloma dijafize tibije. Doktorska disertacija, Medicinski fakultet Nis, 1996.

# KOMPARACIJA OTVORENE I ZATVORENE METODE SPOLJNE FIKSACIJE U LEČENJU ZATVORENIH PRELOMA DIJAFIZE TIBIJE

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## SAŽETAK

**Prelom dijafize tibije predstavlja jedan od najčešćih preloma dugih kostiju koji se sreće u ortopedskoj praksi. Postavljanje ispravne indikacije za vrstu lečenja predstavlja jedan od najodgovornijih trenutaka u procesu lečenja.**

**Prospektivno je praćeno 30 bolesnika sa zatvorenim prelomom dijafize tibije koji su lečeni metodom spoljne fiksacije u periodu od 1.01.2000. godine do 31.12. 2004. godine na Ortopedsko-traumatološkom odeljenju ZC u Ćupriji i Klinici za ortopediju i traumatologiju KC u Nišu. Kod polovine bolesnika, njih 15 (50%), primenjena je zatvorena metoda spoljne fiksacije, a kod druge polovine, 15 (50%) bolesnika, primenjena je otvorena metoda spoljne fiksacije. Kod svih bolesnika je u lečenju primenjen spoljni fiksator Mitković sa konvergentnom orjentacijom klinova.**

**Analizom dobijenih rezultata utvrđeno je da je do zarastanja preloma primenom ove metode lečenja došlo kod 28 (95,7%) bolesnika. Vremenski interval u kome je došlo do zarastanja preloma dijafize tibije iznosi 3,5 - 5,5 meseci. Kod 2 (6,6%) ispitanika, po jedan iz obe grupe, došlo je do formiranja aseptične pseudoartroze. Ispitanici sa pseudoartrozom lečeni su CD aparatom po Mitkoviću i spongioplastikom sa dobrim krajnjim rezultatom. Postoperativni osteitis, kao najteža komplikacija u lečenju zatvorenih preloma dijafize tibije, nije registrovan ni kod jednog bolesnika.**

**Spoljna fiksacija, spoljnim fiksatorom Mitković, u lečenju preloma dijafize tibije obezbedjuje dobre biomehaničke uslove za zarastanje preloma.**

***Ključne reči:*** **zatvoreni prelom dijafize tibije, spoljna fiksacija, spoljni fiksator Mitković**