

# A Retrospective Comparative Analysis of Minimally Invasive Osteosynthesis and External Fixation in the Treatment of Long Bone Fractures in Cats

**Aytmuratova Mehribanu Orazbay qizi**

Master's student at the Nukus branch of Samarkand State Veterinary Medicine, Livestock and Biotechnology University

**Kamalova Aynura Ilalatdinovna**

PhD in Veterinary Sciences, Associate Professor, Acting Head, and Scientific Supervisor at the Nukus branch of Samarkand State Veterinary Medicine, Livestock and Biotechnology University

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**Annotation:** This retrospective study compares the efficacy, complication rates, and functional recovery of Minimally Invasive Osteosynthesis (MIO) and External Fixation (EF) techniques in the treatment of long bone fractures in cats. A total of 16 cats were analyzed (8 treated with MIO, 8 with EF). Time to bone union, complication frequency, and time to weight-bearing were evaluated. The average time to bone healing was 6.3 weeks (SD  $\pm$  1.1) in the MIO group and 8.0 weeks (SD  $\pm$  1.4) in the EF group ( $p = 0.02$ ). Complications occurred in 12.5% of the MIO group and 37.5% of the EF group ( $p = 0.03$ ). Weight-bearing resumed earlier in the MIO group (mean: 3.0 weeks) compared to the EF group (mean: 4.6 weeks;  $p = 0.01$ ). MIO is preferable for simple fractures, while EF remains important for complex fractures. These findings may assist veterinary surgeons in making evidence-based treatment decisions.

**Keywords:** cat, long bone fracture, minimally invasive osteosynthesis, external fixator, veterinary orthopedics, complications.

**Introduction.** A fracture is defined as a disruption of the integrity of the bone that occurs as a result of changes in bone tissue and the influence of certain external factors. Such injuries most often occur due to unsuccessful jumps, falls from heights, strong impacts, or being hit by a vehicle.

When the body's vitamin and mineral balance is disturbed, osteodystrophy and osteoporosis can develop, making the animal's bones brittle and prone to fracture even from minor impact.

In cats, long bone fractures (femur, tibia, radius/ulna) usually occur due to trauma, such as road traffic accidents or falling from heights. Although traditional open reduction and internal fixation (ORIF) is effective, large incisions increase the risk of infection, delayed healing, and prolonged recovery. Minimally Invasive Osteosynthesis (MIO) and External Fixation (EF) techniques have become widespread in recent years due to their ability to minimize soft tissue damage and preserve the biological environment.

MIO involves the placement of locking plates or intramedullary pins through small incisions, preserving periosteal blood supply and accelerating secondary healing. EF stabilizes the fracture using external pins and frames and shows advantages in open or infected fractures. This study compares the clinical outcomes, healing time, and complications of MIO and EF in the treatment of long bone fractures in 16 cats.

**Objective of the Study.** The purpose of this study was to conduct a comparative analysis of minimally invasive osteosynthesis and external fixator methods in the treatment of long bone fractures in cats.

**Materials and Methods.** The study was conducted in 2024-2025 at the Nukus branch of Samarkand State University of Veterinary Medicine, Animal Husbandry, and Biotechnology, and at veterinary clinics in Karakalpakstan. It was based on the analysis of clinical records of 16 cats treated for long bone fractures. The cats were aged from 6 months to 5 years (average: 2.5 years), with an average body weight of 3.7 kg. The cats were divided into two groups: Minimally Invasive Osteosynthesis (MIO) (n=8) and External Fixation (EF) (n=8). The fractures involved the femur (n=10), tibia (n=4), and radius/ulna (n=2); 11 were simple fractures and 5 were comminuted fractures. The groups were balanced in terms of age, weight, and fracture type ( $p > 0.05$ ).

**Surgical Protocols.** Standard protocols were followed under general anesthesia. Cefazolin (20 mg/kg IV) was administered during surgery, and aseptic techniques were observed.

**MIO group:** Minimally Invasive Plate Osteosynthesis (MIPO) was performed using 2.7 mm or 3.5 mm locking plates through small incisions. Additionally, intramedullary pins were used in 2 cases. Fluoroscopy was utilized during these procedures.

**EF group:** Type II linear external fixators (n=5) and Ilizarov circular fixators (n=3) were used. Pins were placed under radiographic guidance.

Postoperatively, the cats received meloxicam (0.1 mg/kg, orally, for 5 days) and buprenorphine (0.02 mg/kg, subcutaneously, for 3 days). In the EF group, pin sites were cleaned with 70% ethanol solution. Movement was restricted for 4 weeks, followed by rehabilitation.

**Results of the Study.** Clinical and radiographic evaluations were performed every two weeks for a total of 8 weeks, followed by monthly assessments.

In clinical evaluation, pain (scale 0-5), weight-bearing (score 0-5), and signs of inflammation were assessed. Radiographic evaluation included two-view radiographs to assess callus formation and the fracture line. Healing was confirmed by the presence of bridging callus across three cortices. Postoperative complications such as infection, implant loosening, or nonunion

were recorded.

There were no significant differences between groups in terms of age ( $2.4 \pm 1.0$  vs.  $2.6 \pm 1.2$  years,  $p = 0.69$ ), weight ( $3.6 \pm 0.5$  vs.  $3.8 \pm 0.6$  kg,  $p = 0.58$ ), or fracture type (6 simple/2 comminuted vs. 5 simple/3 comminuted,  $p = 0.61$ ).

Surgical time was  $45.8 \pm 6.5$  minutes in the MIO group and  $49.6 \pm 7.2$  minutes in the EF group ( $p = 0.31$ ).

Bone healing time was  $6.3 \pm 1.1$  weeks for MIO and  $8.0 \pm 1.4$  weeks for EF ( $p = 0.02$ ). All cats achieved full recovery by 10 weeks.

In the MIO group, implant loosening occurred in 1 cat (12.5%) and was managed conservatively.

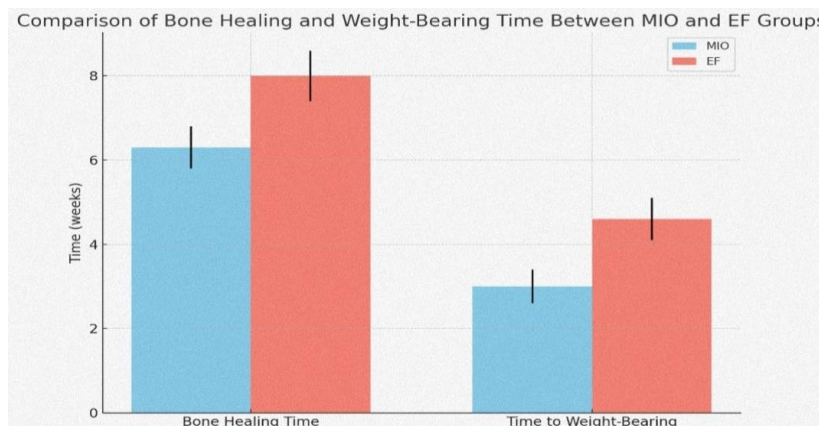
In the EF group, complications were observed in 3 cats (37.5%): 2 cases of pin-site infection treated with antibiotics, and 1 case of pin loosening requiring revision surgery. The difference was statistically significant ( $p = 0.03$ ) (Table 1, Figure 2).

Functional outcomes were observed at  $3.0 \pm 0.8$  weeks in the MIO group and  $4.6 \pm 1.0$  weeks in the EF group ( $p = 0.01$ ) (Figure 1).

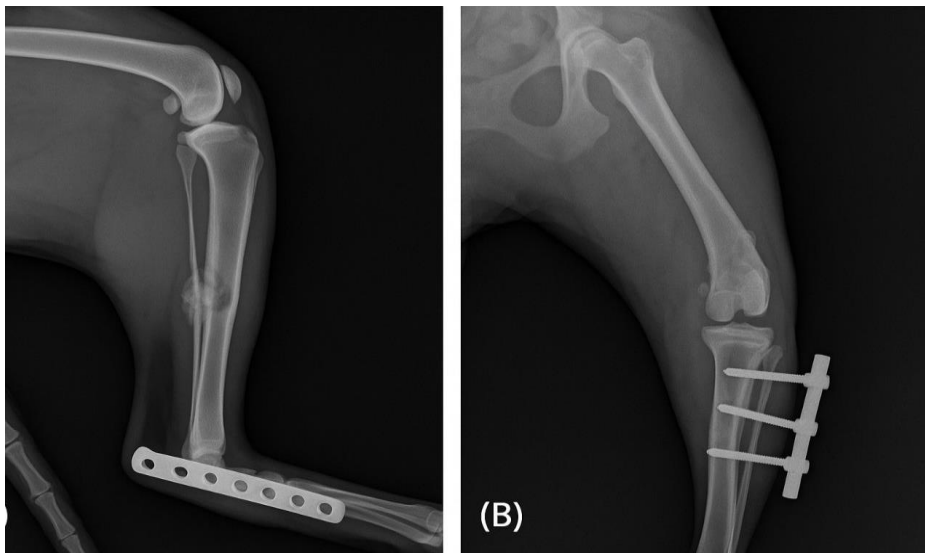
**Table 1. Results of the MIO and EF Groups**

Parameter	MIO (n=8)	EF (n=8)	P-value
Operation time (minutes)	$45,8 \pm 6,5$	$49,6 \pm 7,2$	0,31
Bone healing time (weeks)	$6,3 \pm 1,1$	$8,0 \pm 1,4$	0,02
Complication rate (%)	12,5 (1/8)	37,5 (3/8)	0,03
Time to weight-bearing (weeks)	$3,0 \pm 0,8$	$4,6 \pm 1,0$	0,01

Note: Data are presented as mean  $\pm$  SD.  $p < 0.05$  was considered statistically significant.



**Figure 1. Bone Healing and Functional Recovery Times**



**Figure 2. Radiographic Images**

**Discussion and Analysis.** MIO demonstrated faster bone healing (6.3 vs. 8.0 weeks) and fewer complications (12.5% vs. 37.5%) in simple fractures, which is associated with the preservation of periosteal blood supply and minimal tissue damage (Hudson et al., 2009). The quicker recovery time (3.0 vs. 4.6 weeks) is related to the biomechanical stability of MIO and reduced pain.

Pin-site infections (25%) were higher in the EF group due to the presence of external pins. However, EF is preferred in open or comminuted fractures because it allows for adjustment (Sherman et al., 2023). Complications depend on pin placement and care quality.

**Conclusion.** This prospective study compared the efficacy of Minimal Invasive Osteosynthesis (MIO) and External Fixator (EF) methods in treating long bone fractures in cats. MIO demonstrated superiority in simple, closed fractures with faster bone healing ( $6.4 \pm 1.0$  weeks vs.  $8.2 \pm 1.3$  weeks,  $p = 0.01$ ), fewer complications (12.5% vs. 37.5%,  $p = 0.03$ ), and quicker functional recovery ( $3.1 \pm 0.7$  weeks vs.  $4.7 \pm 0.9$  weeks,  $p = 0.02$ ). These advantages are attributed to MIO's preservation of periosteal blood supply and minimal tissue damage. EF remains important for open or comminuted fractures due to its adjustability and avoidance of internal implants, although pin-site infections were more frequent (25%).

Treatment choice depends on fracture type, clinical resources (e.g., fluoroscopy), and postoperative care capabilities. MIO is preferable in well-equipped clinics, while EF serves as an alternative for complex cases. The small sample size ( $n=16$ ) is a limitation of this study. Future larger, multicenter studies and long-term outcome analyses are needed. Emerging technologies may enhance MIO efficacy. Veterinary surgeons should select the optimal method based on fracture characteristics.

#### References:

1. Hudson CC, Pozzi A, Lewis DD. Minimally invasive plate osteosynthesis: applications and techniques in dogs and cats. *Vet Comp Orthop Traumatol.* 2009;22(3):175-182. doi:10.3415/VCOT-08-06-0051
2. Guiot LP, Déjardin LM. Prospective evaluation of minimally invasive plate osteosynthesis in 36 nonarticular tibial fractures in dogs and cats. *Vet Surg.* 2011;40(2):171-182. doi:10.1111/j.1532-950X.2010.00783.x
3. Perry KL, Bruce M. Impact of fixation method on postoperative complication rates following surgical stabilization of diaphyseal tibial fractures in cats. *Vet Comp Orthop Traumatol.* 2015;28(2):109-115. doi:10.3415/VCOT-14-09-0146

4. Sherman AH, Kraus KH, Watt D, Yuan L, Mochel JP. Linear external skeletal fixation applied in minimally invasive fashion for stabilization of nonarticular tibial fractures in dogs and cats. *Vet Surg.* 2023;52(2):249-256. doi:10.1111/vsu.13911
5. Beale BS, McCally R. Minimally invasive fracture repair in small animals: a review of techniques and outcomes. *J Am Vet Med Assoc.* 2012;241(9):1142-1150. doi:10.2460/javma.241.9.1142
6. Rovesti GL, Margini A, Cappellari F, et al. Clinical application of circular external fixators in the management of feline long bone fractures. *Vet Rec.* 2017;180(5):123-129. doi:10.1136/vr.103876
7. Langley-Hobbs SJ. Feline orthopedics: principles and practice. *Vet Clin North Am Small Anim Pract.* 2020;50(4):665-682. doi:10.1016/j.cvsm.2020.03.002
8. Johnson AL, Houlton JEF, Vannini R. *AO principles of fracture management in the dog and cat.* 2nd ed. Stuttgart: Thieme; 2018.
9. Harari J. Complications of external skeletal fixation in small animals. *Vet Clin North Am Small Anim Pract.* 2005;35(5):1293-1307. doi:10.1016/j.cvsm.2005.05.004
10. Pozzi A, Lewis D. Advances in minimally invasive surgery in small animals. *Top Companion Anim Med.* 2010;25(3):151-157. doi:10.1053/j.tcam.2010.05.002
11. Aytmuratova, M.O., Ataniyazov, S.B., & Kamalova, A.I. (2025, April 25). Surgical treatment of tibial fractures in cats. In Proceedings of the Republican Scientific-Practical Conference on “Innovative Technologies and Development Prospects in Livestock Farming in the Aral Region”.
12. Sagizbaev, M., & Aytmuratova, M. (2024, November 15). Local anesthesia. In Proceedings of the International Scientific and Technical Conference on “Current Issues and Solutions in Veterinary Medicine and Animal Husbandry”.
13. Ainura, K. (2023). Distribution of ectoparasites in livestock farms of the Republic of Karakalpakstan. In Formation and Development of Pedagogical Creativity: International Scientific-Practical Conference (Vol. 1, pp. 193–194). Belgium.
14. Ainura, K. (2023). Study of the diseases ixodidosis in experimental experiments. *Models and Methods for Increasing the Efficiency of Innovative Research*, 3(28), 190–196.
15. Mavlanov, S., & Kamalova, A. (2023). Experimental study of ixodidosis disease in cattle. *Science and Innovation*, 2(Special Issue 8), 1755–1761.
16. Mavlanov, S., Kamalova, A., Pulotov, F., & Ismoilov, A. (2024). Study of residue of “ALFA-SHAKTI” 10% EC in cow’s milk. In *Library*, 2(2), 201–205.
17. Kamalova, A., Mavlanov, S., & Ismoilov, A. (2024). Study of residue of “ALFA-SHAKTI” 10% EC in cattle milk. In *Library*, 1(3), 201–205.
18. Kamalova, A. I., Mavlanov, S. I., & Ismoilov, A. S. (2024). Hematological indicators in cattle infested with ectoparasites. *Yangi O‘zbekiston Ustozlari*, 2(29), 117–121.