



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2025): 4.61

VET 2026; 11(8): 71-73

© 2026 VET

www.veterinarypaper.com

Received: 28-06-2026

Accepted: 02-08-2026

Sahana KM

MVSc Student, Department of
Veterinary Surgery and
Radiology, College of Veterinary
Science, Rajendranagar,
Hyderabad, Telangana, India

TM Rao

Professor and Head of the
Department, Department of
Veterinary Surgery and
Radiology, College of Veterinary
Science, Rajendranagar,
Hyderabad, Telangana, India

Radhakrishna JR

Professor, Department of
Veterinary Surgery and
Radiology, College of Veterinary
Science, Rajendranagar,
Hyderabad, Telangana, India

Padmaja K

Professor and Head of the
Department, Department of
Veterinary Medicine, College of
Veterinary Science,
Rajendranagar, Hyderabad,
Telangana, India

Corresponding Author:

Sahana KM

MVSc Student, Department of
Veterinary Surgery and
Radiology, College of Veterinary
Science, Rajendranagar,
Hyderabad, Telangana, India

Hematological and biochemical changes associated with distal femur fracture healing in cats treated with dynamic cross pinning

Sahana KM, Rao TM, Radhakrishna JR and Padmaja K

DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i8b.3699>

Abstract

A clinical study conducted at the Department of Veterinary Surgery and Radiology, PVNRTVU, Hyderabad, evaluated changes in hematological (TLC, TEC, Hb, PCV and platelets) and biochemical parameters (Ca, P and ALP) following distal femur repair in six cats with dynamic cross pinning using titanium elastic nails. The changes in the calcium, phosphorus and alkaline phosphatase levels were correlated with clinical and radiological findings at regular intervals. In conclusion, serum calcium levels remained consistent throughout the study with a gradual increase in serum phosphorus and alkaline phosphatase levels up to 30th post-operative day coinciding with the active phase of callus formation. No significant changes encountered in the levels of hematological parameters.

Keywords: Distal femur fracture, dynamic cross pinning, titanium elastic nails, feline orthopedics

Introduction

Femoral fractures are among the most frequently reported long-bone injuries in small animals (Philips, 1979; Raghunath *et al.*, 2007; Cardoso *et al.*, 2016) ^[10, 11, 2]. Although diaphyseal fractures predominate, distal femoral fractures present greater surgical complexity due to the limited size of distal fragment and the mechanical influence of surrounding musculature (Stigen, 1986; Harasen, 2001) ^[16, 4]. Young cats are particularly predisposed due to open physes and increased physical activity (Stigen, 1999; Simpson & Lewis, 2003; Keosengthong *et al.*, 2019) ^[17, 14, 5]. Biochemical markers such as calcium, phosphorus and alkaline phosphatase play a vital role in bone metabolism and mineralization. The objective of this study was to evaluate biochemical changes associated systemic physiological responses following stabilization of feline distal femoral fractures using crossed titanium elastic nails.

Materials and Methods

The study was conducted in six cats presented at Department of Veterinary Surgery and Radiology, college of Veterinary Science, PVNRTVU, Hyderabad. Six cats of either sex aged 3-24 months and weighing between 1.8-2.5kg were included in the study. Most cats were presented with a history of fall from height. Pre-operative clinical and radiographic examination, revealed five cats with closed, complete supracondylar femur fractures and one cat with distal femur fracture.

All cats underwent hematological and biochemical evaluation before the surgery. The surgical procedure was performed under propofol (3-4mg/kg) anesthesia following pre-anesthetic medication with xylazine (1mg/kg IM), butorphanol (0.2mg/kg IM) and midazolam (0.2mg/kg IV). All six cats were surgically managed through a craniolateral approach to the distal femur with dynamic cross pinning technique using titanium elastic nails of 1-1.5mm size.

Blood samples were collected from cat at regular intervals 15th, 30th and 60th post-operative days. The hematological parameters like total leucocytic count, total erythrocyte count, hemoglobin, PCV and platelets are estimated along with biochemical parameters such as calcium, phosphorus and alkaline phosphatase values during fracture healing period. All the data were subjected to one way ANOVA to find the level of significance.

Results and Discussion

In the present study, total leukocyte count exhibited a mild elevation from the pre-operative period to the 15th post-operative day, after which values gradually declined towards baseline. This temporary leukocytosis represents a normal physiological response to surgical intervention and acute tissue inflammation. Surgical manipulation activates the innate immune system, leading to increased release of pro-inflammatory mediators such as IL-1, IL-6, and TNF- α . These cytokines stimulate bone marrow leukopoiesis and promote

mobilization of neutrophils into circulation. These mechanisms explain the transient rise observed in this study and align with the findings of Maiti *et al.* (1999) [7], Suryawanshi *et al.* (2001) [18] and Aithal *et al.* (1999) [1], who attributed post-operative leukocytosis to stress, pain, tissue trauma, and corticosteroid-mediated leukocyte redistribution. Hematological values of all six are presented in a Table1. Other haematological parameters including total erythrocyte count, hemoglobin concentration, platelet count, and packed cell volume remained stable throughout the study period.

Table 1: Haematological values of six cats under study (Mean $\pm$ SE)

Parameters	Pre-operative	Post-operative(day)			F value	p value
		15 th	30 th	60 th		
TLC (10 ³ / μ L)	9.29 $\pm$ 0.58	11.15 $\pm$ 0.81	10.76 $\pm$ 0.50	10.47 $\pm$ 0.36	1.870	0.166
TEC (10 ⁵ / μ L)	5.67 $\pm$ 0.44	5.73 $\pm$ 0.18	5.62 $\pm$ 0.18	5.65 $\pm$ 0.22	0.0273	0.993
Hb (g/dL)	10.58 $\pm$ 0.40	10.80 $\pm$ 0.30	10.68 $\pm$ 0.30	10.85 $\pm$ 0.29	0.133	0.939
PCV (%)	39.83 $\pm$ 2.80	39 $\pm$ 1.59	39.83 $\pm$ 0.91	41.00 $\pm$ 1.46	0.203	0.893
Platelets (10 ³ / μ L)	249.83 $\pm$ 0.30	250.50 $\pm$ 0.30	251.50 $\pm$ 0.34	250.33 $\pm$ 0.33	2.01	0.143

In the present study, mean serum calcium levels remained consistent across all post-operative intervals, with no statistically significant fluctuations. This stability indicates that the fracture healing process did not impose sufficient metabolic demand to disrupt systemic calcium homeostasis (Pandey and Udupa (1981) [9] and Mahendra *et al.* (2007) [6]. Serum phosphorus levels showed a gradual increase up to the 30th post-operative day, coinciding with the active phase of callus formation, and subsequently returned to baseline values. The variations observed across different post-operative intervals were statistically significant. This transient rise in phosphorus is physiologically expected, as phosphorus is a key component of hydroxyapatite, and its increased utilization during early mineralization reflects heightened osteoblastic activity. Similar trends were reported by Nilsson and Westlin (1972) [8], Rao *et al.* (2001) [12] and Saini *et al.* (2024) [13], who also associated elevated phosphorus levels with the peak mineral deposition phase of fracture healing. Serum alkaline phosphatase (ALP) concentrations exhibited a

gradual increase up to the 30th post-operative day, coinciding with the phase of intense osteoblastic proliferation and active callus formation. This rise reflects the heightened metabolic activity associated with new bone deposition, as ALP is a key enzyme produced by osteoblasts during matrix synthesis and mineralization. Subsequently, ALP levels began to decline and approached baseline values by the 60th post-operative day, corresponding with the transition from callus formation to the bone-remodeling phase. These temporary fluctuations closely parallel the trends reported by Nilsson and Westlin (1972) [8] who observed post-operative ALP normalization by approximately two months. The post-operative elevation in ALP has been widely acknowledged as a biochemical marker of osteogenesis (Pandey and Udupa, 1981; Wildburger *et al.*, 1994 and Rao *et al.*, 2001) [9, 21, 12]. Similar patterns have been documented in feline and canine orthopedic studies by Uma Rani and Ganesh (2004) [20, 3], Mahendra *et al.* (2007) [6], and Saini *et al.* (2024) [13]. Biochemical parameters are recorded in table 2.

Table 2: Biochemical parameters in six cats under study (Mean $\pm$ SE)

Parameters	Pre-operative	Post-operative(days)			F value	p value
		15 th	30 th	60 th		
Calcium (mg/dl)	9.45 $\pm$ 0.18	9.75 $\pm$ 0.09	9.85 $\pm$ 0.09	9.65 $\pm$ 0.09	1.785	0.182
Phosphorus (mg/dl)	6.52 $\pm$ 0.28	7.17 $\pm$ 0.22	7.62 $\pm$ 0.15	6.83 $\pm$ 0.14	5.073	0.0089
ALP (U/L)	55 $\pm$ 3.69	76.83 $\pm$ 4.68	124 $\pm$ 13.45	77.67 $\pm$ 5.87	13.45	0.000049

Conclusion

The changes in hematological and biochemical parameters were compared with clinical and radiographic findings and the parameters remained within the physiological limits throughout the observation period. A mild elevation in TLC during 15th post-operative day, indicating a normal inflammatory response. Serum phosphorus and alkaline phosphatase levels showed a gradual increase upto 30th post-operative day, suggestive of ongoing bone remodeling activity, while serum calcium concentrations remained stable without significant variation. Overall these findings support an uncomplicated post-operative course and satisfactory fracture healing.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Aithal HP, Singh GR. Management of supracondylar femoral fracture with different techniques in dogs: A gross and undecalcified ground section study. Indian Journal of Animal Sciences. 1999;69:908-911.
2. Cardoso CB, Rahal SC, Agostinho FS, Mamprim MJ, Santos RR, Filho ES. Long bone fractures in cats: A

- retrospective study. *Veterinary and Zootechnical Sciences*. 2016;23(3):504-509.
3. Ganesh TN, Dwivedi DK, Pushkinraj H, Syam KV, Ramani C, Jayaprakash R, *et al.* Surgical management of supracondylar fracture of femur in a dog. *Indian Journal of Veterinary Surgery*. 2004;25(1):48-49.
 4. Harasen G. Fractures involving the distal extremity of the femur. Part 1. The immature patient. *Canadian Veterinary Journal*. 2001;42:949-950.
 5. Keosengthong A, Naruepon K, Supranee J, Suvaluk S, Panisara K, Somphong H. Incidence and classification of bone fracture in dogs and cats: A retrospective study at a veterinary teaching hospital, Khon Kaen University, Thailand (2013-2016). 2019;20(46):127-139.
 6. Mahendra AM, Ranganath L, Vasanth MS. Effect of polymethylmethacrylate in femoral fracture repair on hemato-biochemical parameters in dogs. *Indian Veterinary Journal*. 2007;84:587-589.
 7. Maiti BK, Sen TB, Sanki S. Haemato-biochemical changes following application of Ilizarov technique in treatment of femur fractures in dogs. *Indian Journal of Animal Health*. 1999;38:133-134.
 8. Nilsson BE, Westlin NE. The plasma concentration of alkaline phosphatase, phosphorus and calcium following femoral neck fracture. *Acta Orthopaedica Scandinavica*. 1972;43(6):504-510.
 9. Pandey AK, Udupa KN. Studies on variations in haematobiochemical profile of dogs treated with titanium elastic stable intramedullary nailing for long bone fractures. *Indian Journal of Animal Research*. 1981;55(3):123-128.
 10. Philips R. A survey of bone fractures in the dog and cat. *Journal of Small Animal Practice*. 1979;20:661-674.
 11. Raghunath M, Yadav RMS, Singh SS. Distribution and classification of canine long bone fractures. *Indian Veterinary Journal*. 2007;84:1243-1246.
 12. Rao TM, Lakshmipathi GV, Sastry TP, Ramakrishna O. Biochemical changes following ulnar segmental defect repair with fibrillar collagen-hydroxyapatite and porous hydroxyapatite implants in canines. *Indian Journal of Animal Research*. 2001;35(2):112-115.
 13. Saini D, Khandekar GS, Tripathi SD, Gaikwad SV, Chauhan SA, Patil H. Comparative study of arrow pinning and dynamic intramedullary cross pinning for surgical management of long bone fractures in cat. PhD thesis. Nagpur: Maharashtra Animal and Fishery Sciences University; 2024.
 14. Simpson DJ, Lewis DD. In: Slatter D, editor. *Textbook of small animal surgery*. 3rd ed. Philadelphia: Elsevier Science; 2003. p. 2059-2089.
 15. Sodhi HS, Kumar A, Anand A, Sangwan V, Singh O. Comparison of titanium elastic nailing and end-threaded intramedullary pinning for distal femoral fractures in young dogs. *Indian Journal of Animal Research*. 2023;57(9):1186-1193.
 16. Stigen O. Femoral fractures in the dog and cat. 1. Location, type of fracture and occurrence. *Norsk Veterinaertidsskrift*. 1986;98(1):13-18.
 17. Stigen O. Supracondylar femoral fractures in 159 dogs and cats treated using a normograde intramedullary pinning technique. *Journal of Small Animal Practice*. 1999;40:519-523.
 18. Suryawanshi SB, Maiti B, Singh GR. A comparative study of two different fixation techniques in management of tibial metaphyseal fracture in dogs. *Applied Animal Research*. 2001;20:89-98.
 19. Swaroop R, Manjunath DR, Nagaraju N, Ganga Naik S, Shivakumar V, Shilpa VT, *et al.* Clinical evaluation of stainless steel and titanium elastic nails for femur fracture repair in young dogs. *The Indian Journal of Veterinary Sciences and Biotechnology*. 2024;20(4):50-54.
 20. Uma Rani R, Ganesh TN. Study of serum calcium, phosphorus and alkaline phosphatase during fracture healing of femur in goats. *Indian Veterinary Journal*. 2003;80:377-378.
 21. Wildburger R, Zarkovic N, Dobnig H, Petek W, Hofer HP. Post-traumatic dynamic change of carboxy terminal propeptide of type I procollagen and alkaline phosphatase in patients with severe head injury and fractures. *Journal of Bone and Mineral Research*. 1994;9(10):1715-1721.

How to Cite This Article

Sahana KM, Rao TM, Radhakrishna JR, Padmaja K. Hematological and biochemical changes associated with distal femur fracture healing in cats treated with dynamic cross pinning. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026; 11(8): 71-73.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.