Indian J. Vet. Surg. 46(2): 126-129 December 2025

ijvs

Clinical evaluation of end-threaded, positive-profile, screw-tipped, Steinmann pinning for management of femur fractures in dogs

Stanzin Tsela[1], Amit Kumar[2†], S.P. Tyagi[3], Adarsh Kumar[3], Rohit Kumar[2], Aditi Sharma[1], Anjna Negi[1], Anmol Mehta[1], Deepti Sharma[2], Deepti Bodh[2], Basava Gagan[1] and Sanyav Bhardwaj[1]

CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur-176062 (Himachal Pradesh)

[1]MVSc Scholar, [2]Assistant Professor, [3]Professor, Department of Veterinary Surgery and Radiology, Department of Veterinary Surgery and Radiology, Dr G.C. Negi College of Veterinary and Animal Sciences, Palampur

DOI: 10.5958/0973-9726.2025.00033.5 *Received: October, 2024*

The present study was undertaken to evaluate the efficacy of a positive-profile, end-threaded Steinmann intramedullary (Admit) pin for the management of femoral fractures in dogs. A total of 41 dogs with various types of diaphyseal femoral fractures were included. The animals ranged from one month to four years of age (juvenile d" 1 yr, n = 37; adult 1 - 7 yr, n = 4) and weighed between 2.5 kg and 33 kg. All patients underwent detailed clinical, orthopaedic, and neurological examinations, followed by radiographic assessment (orthogonal projections) immediately after surgery and at regular intervals until radiographic evidence of fracture union was observed. Postoperatively, inflammation, pain on palpation, and lameness progressively decreased in all dogs. Intraoperatively, the extent of soft-tissue damage and technical difficulty were rated as moderate to high; however, fracture reduction and fixation stability were consistently graded as good to excellent. By the final reappraisal (49.17±6.93 days post-operatively), radiographic healing was complete in most cases, with 95.23% categorized in fracture healing grades 1 and 2. Weight-bearing improved markedly from a mean score of 0.7 on the day of implant fixation to 9.2 at the final evaluation, and 24 of the 29 dogs re-evaluated achieved full weight bearing. Overall, the clinical outcome was rated as good to excellent in the majority of cases. These findings suggest that positive-profile, end-threaded Steinmann intramedullary pinning is an effective and reliable technique for stabilizing diaphyseal femoral fractures in dogs.

Keywords: *End-threaded positive profile screw tipped pin, Admit pin, Femur, Fracture, Intra-medullary pinning*

In small animals, internal fracture fixation has advanced considerably, offering a wide array of implant options for the management of femoral fractures. Appropriate selection of the fixation technique is crucial for achieving optimal outcomes across different fracture configurations. An ideal fixation method should provide sufficient stability to maintain fracture alignment throughout healing, while permitting controlled micromotion at the fracture site to promote external callus formation and early functional limb use. Intramedullary (IM) pinning remains one of the most commonly employed and cost-effective internal fixation methods in veterinary orthopaedics (Chanana *et al*., 2018; Shivhare *et al*., 2023). Over time, IM pins have evolved from simple smooth Steinmann pins to end-threaded designs, progressing from negative-profile to positive-profile configurations. Previous studies have demonstrated that threaded pins offer distinct biomechanical advantages over smooth pins, including improved resistance to bending, compression, and rotational forces, as well as reduced incidences of implant migration (DeCamp *et al*., 2015; Chanana *et al*., 2018). Given these advantages, the present study was undertaken to evaluate the clinical efficacy of IM pinning using a positive-profile, end-threaded Steinmann (Admit) pin for the stabilization and management of diaphyseal femoral fractures in dogs.

Materials and Methods

A total of 41 dogs presented with diaphyseal femoral fractures were treated using IM pinning with an end-threaded, positive-profile, screw-tipped Steinmann pin (Admit pin), with or without adjunctive cerclage wiring, between May 2023 and September 2024. Dogs with a history of trauma and/or non - weight-bearing lameness underwent comprehensive clinical, orthopaedic, and neurological examinations, followed by radiographic evaluation in mediolateral and craniocaudal projections to confirm the presence and type of femoral fracture. The dogs ranged in age from one month to four years (juvenile d" 1 yr, n = 37; adult 1 - 7 yr, n = 4) and weighed between 2.5 kg and 33 kg. Preoperative radiographs were used to measure the narrowest medullary canal diameter, and the intramedullary pin size was selected to occupy approximately 70% of the medullary cavity.

All dogs with a history of trauma and/or non-weight-bearing lameness underwent a comprehensive clinical, orthopaedic, and neurological examination. The assessments included evaluation of the degree of inflammation (score 0 - 3), pain on palpation (score 0 - 3), and weight-bearing status (score 0 - 10), following the scoring systems described by Sakshi (2019), Singh (2022), and Kumar (2023). Additional parameters such as the degree of lameness, fracture location, and presence of crepitus were also recorded. Radiographic

†Corresponding author; E-mail: drasingla@gmail.com

examination in mediolateral and craniocaudal projections was then performed to confirm and characterize the femoral fractures.

A standard craniolateral approach to the femur was performed as described by Brinker (1957). Intraoperatively, the extent of manipulation and soft-tissue damage, the degree of technical difficulty, the quality of fracture reduction, and the stability of fracture fixation were assessed and recorded. Additional observations, including implant size, duration of surgery, use of cerclage wires, and the need for bone nibbling, were also documented.

Follow-up clinical and radiographic examinations were performed during each reappraisal. Clinical observations included the degree of inflammation, pain on palpation, presence of muscle atrophy, and weight-bearing status. The time required for the patient to initiate weight bearing was also documented. Radiographic evaluation of fracture healing was carried out using the callus grading system described by Hammer *et al.* (1985) (Table 1). Clinical outcome and limb function were assessed using the evaluation scales proposed by McCartney (1998) and Fox *et al.* (1998) (Table 2).

Table 1: Grading of fracture healing (Hammer *et al*., 1985).

Grade	1	2	3	4	5
Callus formation	Homogenous bone structure	Massive bone trabeculae crossing the fracture line	Apparent bridging of the fracture	No bridging of the formation	No callus formation
Fracture line	Obliterated	Barely discernible	Discernible	Distinct	Distinct
Stage of union	Achieved	Achieved	Uncertain	Not achieved	Not achieved

Table 2: Clinical Outcome Scale (Fox *et al.,* 1998).

Clinical outcome	Description of function
Excellent	No lameness, clinically within normal limits
Good	Mild lameness noted after extensive exercise
Fair	Mild to moderate intermittent lameness but consistent weight-bearing
Poor	Non-weight bearing lameness

Results and Discussion

The diaphyseal femoral fractures diagnosed in the study ranged from simple spiral fractures (32A2) to segmental complex fractures (32C2). The distribution of fracture types was as follows: simple spiral fractures 32A2 (n = 6), simple oblique fractures e"30° 32A1 (n = 11), simple transverse fractures <30° 32A3 (n = 7), spiral wedge fractures 32B1 (n = 11), bending wedge fractures 32B2 (n = 2), and segmental complex fractures 32C2 (n = 4). All fractures were managed using an end-threaded, positive-profile, screw-tipped Steinmann (Admit) pin, with or without cerclage wiring, depending on the requirements of the individual case.

Preoperatively, inflammation and pain scores averaged 2.20±0.11 (moderate to severe) and 1.96±1.15 (mild to moderate), respectively. At presentation, inflammation was mild in 1 case, moderate in 19 cases, and severe in 17 cases. Pain on palpation was mild in 11 cases, moderate in 18 cases, and severe in 12 cases. Intraoperatively, the extent of manipulation and soft-tissue damage, as well as the degree of technical difficulty, were rated as moderate to high. However, fracture reduction and fixation quality were consistently graded as good to excellent.

Postoperative evaluations were available for 29 of the 41 cases that returned for reappraisal. At the final reappraisal, 17 dogs showed no inflammation, 10 exhibited mild inflammation, and 2 had moderate inflammation. The mean inflammation score improved substantially, decreasing from 2.2 on the implant fixation day to 0.4 at the final follow-up. Pain on palpation had resolved completely in 21 dogs, while 8 showed mild discomfort. Muscle atrophy was absent in 19 cases, mild in 8, and moderate in 2. Weight-bearing scores improved markedly from a mean of 0.79±0.18 at presentation to 9.27±0.35 at the final reappraisal. Of the 29 dogs evaluated, 24 achieved full weight bearing, 2 showed slight lameness, 2 moderate lameness, and 1 remained non - weight-bearing.

Fracture healing was assessed in 21 of the 29 reappraised cases using the grading system described by Hammer *et al.* (1985). Eight cases were excluded because their final reappraisal occurred too early to assign an accurate healing grade. Among the evaluated cases, 95.23% were classified as grade 1 or 2, reflecting various stages of bridging callus formation and progression toward fracture union. The favourable healing observed may be attributed to the snug fit of the Admit pin within the spongy bone, which preserves medullary circulation and facilitates early bone regeneration and abundant callus formation, as previously reported by Chanana *et al*. (2018).

Fig. 1: Representative radiographs of some cases.

Femur fracture repaired by 5.5x4.0 mm end threaded positive profile Steinmann pin and cerclage wires

FRD radiographs on day 90

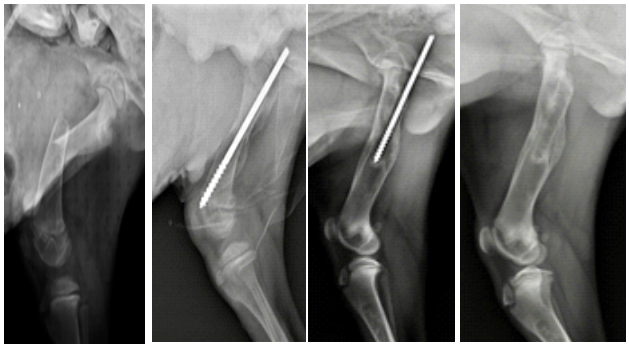
Femur fracture repaired by 4.5x 3.5 mm end threaded positive profile Steinmann pin and cerclage wires

FRD radiographs on day 50

Femur fracture repaired by 5.5x 5=4.0mm end threaded positive profile Steinmann pin and cerclage wires

FRD radiographs on day 124

Radiographically, proximal migration of the implant was observed in 9 cases, and in 5 of these dogs, the implant pierced the skin, causing injury. Following implant removal, the wounds healed uneventfully, and no long-term adverse effects were reported. Threaded pins are generally considered to prevent migration by anchoring securely in cancellous bone, as noted by Ozsoy (2004) and supported by Altunatmaz *et al*. (2012)



Femur fracture repaired by 5.5x 5=4.0mm end threaded positive profile Steinmann pin and cerclage wires

FRD radiographs on day 124

and Kumar (2023). The migration observed in this study may be attributed to the fact that most patients (n=37) were juveniles, who typically have a larger medullary canal, and to the challenges of restricting postoperative activity in active young dogs.

The mean day of initial weight bearing was 5.46±0.40 days, ranging from 3 to 11 days postoperatively. These results are consistent with Shivhare *et al*. (2023), who reported partial weight bearing between 7 and 14 days post-surgery, and with findings by Altunatmaz *et al.* (2012) and Chanana *et al.* (2018). Early weight bearing likely reflects the rigid stabilization provided by the end-threaded, positive-profile Steinmann pin. Additionally, the predominantly juvenile patient population may have contributed to faster bone healing, as previously suggested by Sarrau *et al.* (2007). Overall, clinical outcome scores were rated as good to excellent in most cases.

In conclusion, intramedullary pinning using an end-threaded, positive-profile, screw-tipped (Admit) pin, with or without cerclage wiring, provided successful surgical outcomes in the management of femoral fractures ranging from simple transverse to segmental complex diaphyseal fractures. Dogs demonstrated early weight bearing, with a mean of 5.46 days post-surgery, reflecting the stable fixation achieved with this implant.

References

Altunatmaz, K., Ozsoy, S., Mutlu, Z., Devecioglu, Y. and Guzel, O. 2012. Use of intramedullary fully-threaded pins in the fixation of feline and canine humeral, femoral and tibial fractures. *Vet. Comp. Orthop. Traumatol.* **25:** 321-325.

Brinker, W.O. 1957. Fractures. *In*: *Canine Surgery*, K. Mayer, J.V. Lacroix and H.P. Hoskins (Eds), 4th edn. Santa Barbara: American Veterinary Publications.

Chanana, M., Tyagi, S.P., Singla, A.K., Sharma, A.K. and Farooq, U.B. 2018. End-threaded intramedullary positive profile screw ended self-tapping pin (Admit pin) - a cost-effective novel implant for fixing canine long bone fractures. *Vet. World* **11:** 181-185.

DeCamp, C.E. 2015. *Brinker, Piermattei and Flo's Handbook of Small Animal Orthopaedics and Fracture Repair.* Elsevier Health Sciences.

Fox, S.M., Bray, J.C., Guerin, S.R. and Burbridge, H.M. 1998. Antebrachial deformities in the dog: Treatment with external fixation. *J. Small Anim. Pract.* **36:** 315-320.

Hammer, R.R., Hammerby, S. and Lindholm, B. 1985. Accuracy of radiologic assessment of tibial shaft fracture union in humans. *Clin. Orthop. Relat. Res.***199:** 233-238.

Kumar, A. 2023. Diagnosis and management of musculoskeletal injuries of hind limb in dogs. Doctoral Dissertation, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (Himachal Pradesh), India.

McCartney, W.T. 1998. Use of modified acrylic external fixator in 54 dogs and 28 cats. *Vet. Rec.***143:** 330-334.

Ozsoy, S. 2004. Fixation of femur, humerus and tibia in cats using intramedullary threaded Steinmann pins. *Vet. Rec.* **155:** 152-153.

Piermattei, D.L., Flo, G.L., DeCamp, C.E. and Brinker, W.O. 2006. *Brinker, Piermattei, and Flo's Handbook of Small Animal Orthopedics and Fracture Repair*. Saunders Elsevier, St. Louis, Missouri, USA.

Sakshi. 2019. Anatomically contoured intramedullary interlocking nailing for fixation of femoral fractures in dogs. MVSc Thesis, Department of Veterinary Surgery and Radiology, CSK Himachal Pradesh KrishiVishvavidyalaya, Palampur (Himachal Pradesh), India.

Sarrau, S., Meige, F. and Autefage, A. 2007. Treatment of femoral and tibial fractures in puppies by elastic plate osteosynthesis. *Vet. Comp. Orthop. Traumatol.* **20:** 51-58.

Shivhare, M., Tyagi, S.K., Malik, V., Kumar, V., Singh, C.K. and Singh, P.K. 2023. Evaluation of end-threaded positive and negative profile intramedullary pins for management of long bone fractures in dogs. *Indian J. Anim. Res.* doi: 10.18805/IJAR.B-5029.

Singh, S., Kumar, A., Kumar, A., Tyagi, S. and Sharma, M. 2022. Intramedullary implant fixation for management of diaphyseal fractures of humerus in dogs. *Haryana Vet* .**61:** 9-13.