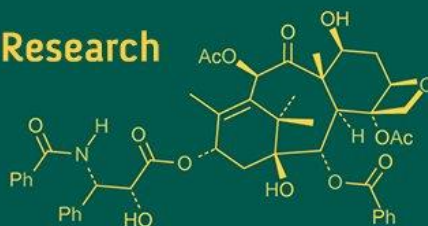


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Comparative study of femoral diaphyseal fracture repair using intramedullary pin and intramedullary horn peg in dogs

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Abstract

Diaphyseal femoral fractures in young dogs, mainly from road traffic accidents, were confirmed radiographically and managed by open reduction and internal fixation using retrograde intramedullary implants sized to about 70% of the medullary canal. Group A received intramedullary Steinmann pinning with cerclage wire augmentation, while Group B was treated with radiolucent intramedullary horn peg fixation supported by zap-straps. Over a 60-day follow-up both groups showed steady, satisfactory recovery with good to excellent weight bearing by days 30-45, normal physiological and haemato-biochemical profiles throughout, and radiographic union by day 60. Horn pegs demonstrated acceptable biocompatibility because they are radiolucent facilitated better fracture visualization; despite occasional minor loosening, their performance and low cost make them a practical, economical option for femoral fracture repair in resource-limited settings.

Keywords: Canine femur, diaphyseal fracture, intramedullary horn peg and Steinmann pin, buffalo horn implant, ORIF

Introduction

Femoral fractures accounted for 37.83% of canine fractures at the Veterinary College Hospital, Bengaluru (July 2024-June 2025), mostly diaphyseal (56.64%) in males under 1 year (58.02%) and frequently due to automobile trauma (59.26%). Rising pet ownership and vehicular activity have increased long-bone fractures in small animal practice (Piermattei *et al.*, 2006; Kushwaha *et al.*, 2011) [8, 9]. While some fractures heal conservatively, inadequate treatment risks malalignment, contracture and chronic dysfunction, and articular injuries often progress to osteoarthritis (Anderson *et al.*, 1993) [1]. Open reduction and internal fixation (ORIF) with intramedullary devices remain the standard for femoral diaphyseal fractures because it restores anatomical alignment and provides stable fixation that permits early mobilization (Beale, 2004) [3]. Conventional stainless-steel intramedullary pinning (IMP) with Steinmann pins provides rigid stabilization but carries risks such as pin migration and infection; consequently, Interest has therefore turned to local biological alternatives: studies of bovine and buffalo horn implants show promising results, and buffalo horn pegs provide semi-rigid support, radiolucency for easier radiographic assessment, biocompatibility and low cost (Singh & Singh, 1990b; Dubey, 1991; Kulkarni, 2000) [10, 11, 12]. This study compares clinical efficacy, healing and complications of intramedullary buffalo horn pegs versus conventional Steinmann pins in 12 dogs to assess horn peg as a practical, affordable option for field practice.

Materials and Methods

The clinical study was conducted on 12 dogs presented to the Department of Veterinary Surgery and Radiology, Veterinary College Hospital, Hebbal, Bengaluru, for repair of femoral fractures, irrespective of breed, age or sex. Dogs with a history and clinical signs suggestive of femur fracture were subjected to detailed physical, clinical, physiological and radiographic examination to confirm diaphyseal femoral fracture, and only cases free from concurrent neurologic, metabolic or infectious disease were included.

The animals were randomly divided into two groups of six each: Group A underwent open reduction and internal fixation using intramedullary Steinmann pin, while Group B underwent repair using intramedullary horn peg prepared from buffalo horn. Femoral fractures were recorded over a

12-month period from July 2024 to June 2025, and case history including breed, age, gender, duration of fracture, concurrent illness and aetiology was documented for all animals. The design of the study is summarized in Table 1 and 2.

Table 1: Anamnesis of dogs that underwent femur fracture repair in Group A

Case No.	Breed	Age (months)	Sex	B. Wt. (kg)	Aetiology	Limb affected	Duration of illness (days)
1	Non-descript	12	Male	15	Automobile accident	Right	3
2	Labrador Retriever	18	Female	25	Fall from height	Right	4
3	Non-descript	6	Male	11	Automobile accident	Right	3
4	Non-descript	8	Male	9	Automobile accident	Right	4
5	Non-descript	5	Female	8	Automobile accident	Left	8
6	Non-descript	6	Male	17	Automobile accident	Left	2

Table 2: Anamnesis of dogs that underwent femur fracture repair in Group B

Case No.	Breed	Age (months)	Sex	B. Wt. (kg)	Aetiology	Limb affected	Duration of illness (days)
1	Golden Retriever	8	Female	18	Automobile accident	Right	4
2	Non-descript	4	Male	8	Automobile accident	Left	3
3	Non-descript	3	Male	7	Automobile accident	Left	4
4	Non-descript	6	Male	10	Automobile accident	Left	3
5	Non-descript	7	Male	12	Automobile accident	Left	4
6	Non-descript	3	Male	5	Automobile accident	Left	1

Preparation of intramedullary horn peg

Buffalo horns were collected from cadavers, and the compact upper third was used to prepare the pegs. The horn was cut longitudinally, shaped into rectangular strips, and ground into intramedullary pegs with one-pointed end for retrograde insertion and one blunt end. (Fig 1-4).



Fig 1: Buffalo horn



Fig 2: Cutting of buffalo horn



Fig 3: Preparation of horn peg on grinding machine



Fig 4: Horn pegs

Clinical and radiological evaluation

Radiological assessment of fracture healing was performed by taking orthogonal views of the affected limb immediately after surgery and on post-operative days 7, 15, 30, 45 and 60 to evaluate implant fixation, fracture apposition, stability and progression of union in diaphyseal femoral fractures treated with intramedullary pin or intramedullary horn peg. At the same time, clinical assessment of weight-bearing pattern and functional limb usage was recorded on the same days, with lameness graded as poor, fair, good or excellent

according to Foutz *et al.* (1991) ^[5] and functional limb use evaluated according to Vasseur *et al.* (1995) ^[15].

Pre-operative preparation and surgical procedure

The dogs were fasted for 12 hours for food and 6 hours for water before surgery. The surgical site was prepared aseptically with spirit and 7.5% povidone iodine. Pre-medication included ceftriaxone, meloxicam, atropine sulphate and xylazine, followed by thiopentone sodium (12.5 mg/kg IV) for induction and maintenance of anaesthesia. The dogs were positioned in lateral recumbency with the affected limb uppermost (Fig.5), and the limb was suspended briefly before surgery; the operative field was then repainted and draped aseptically. A craniolateral incision was made from the greater trochanter to the patella, the tensor fascia lata was incised (Fig. 6), the biceps femoris was retracted caudally and the vastus lateralis was exposed to visualize the femur (Fig. 7). In Group A, a Steinmann pin equal to about 70% of the narrowest medullary canal diameter was inserted retrogradely and advanced into the distal fragment, with cerclage wires applied when necessary. In Group B, a horn peg of similar size was prepared, the proximal fragment was pre-drilled (fig.15), and the peg was inserted retrogradely (Fig.16) and advanced into the distal fragment, with zap straps used as needed for ancillary fixation (Fig.17).

Surgical procedure of group a dogs



Fig 5: Patient positioned in lateral recumbency with the affected side upwards.



Fig 6: Photograph showing Tensor fascia lata incision.



Fig 7: Photograph showing exposure of the fractured femur



Fig 8: Photograph showing retrograde insertion of Steinmann pin



Fig 9: Photograph showing retrograde insertion of Steinmann pin



Fig 10: Tensor fascia lata was closed with continuous lockstitch pattern.



Fig 11: Photograph showing closure of skin incision in cross mattress pattern.

Surgical procedure of group b dogs



Fig 12: Photograph showing positioning of the animal for surgery



Fig 13: Photograph showing Tensor fascialata incision



Fig 14: Photograph showing exposure of the fractured femur



Fig 15: Photograph showing retrograde insertion of Steinmann pin



Fig 16: Photograph showing retrograde insertion of horn peg with pre-drilled passage.



Fig 17: Photograph showing ancillary fixation of zap strap



Fig 18: Photograph showing Tensor fascia lata was closed with continuous lockstitch pattern



Fig 19: Photograph showing closure of skin incision in cross mattress pattern.

Post-operative care and management

Owners were advised to use an Elizabethan collar until suture removal. Cephalexin (20 mg/kg BID) was given for 7 days and carprofen (2 mg/kg SID, oral) for 3 days, with the wound dressed using povidone iodine ointment on alternate days. Skin sutures were removed on day 10 after assessing

wound healing. Movement was restricted for 15 days, followed by short leash walks, limb flexion-extension exercises and massage for the next few weeks to support recovery and prevent muscle atrophy.

Results And Discussion

Physiological, haematological and biochemical results (pre-op, 0, 7, 15, 30, 45 and 60 days) for rectal temperature, heart rate and respiratory rate remained within normal limits in both groups these findings align closely with Tembhurne *et al.* (2010) ^[14] and Srinivas (2022) ^[13]. Haematological (TEC, Hb, TLC, PCV, differential counts) and biochemical (serum creatinine, ALT, ALP, calcium, phosphorus) values remained within reference ranges throughout follow-up these findings align closely with Yadav *et al.* (2021) ^[16]. Statistically significant within-group changes ($p < 0.05$) were limited and included intermittent neutrophilia, transient lymphopenia and modest increases in ALP and phosphorus at time points consistent with bone healing this aligns with Mahendra *et al.* (2007) ^[6].

Post-operative function and weight bearing both groups showed progressive improvement. In Group A most dogs achieved partial weight bearing by 15-30 days, attempted weight bearing by day 30 and full weight bearing by day 45; one dog reached Grade I lameness only by day 60. In Group B early recovery was faster most dogs were Grade III by day 15 and Grade II by day 30; one dog remained Grade II until day 45. All dogs in both groups reached Grade I lameness by day 60. These findings align with Badigera (2013) ^[2].

Functional limb usage in group a dogs



Before Surgery



0th Day



7th Post-op Day



15th Post-op Day



30th Post-op Day



45th Post-op Day



60th Post-op Day

Functional limb usage in group b dogs



Before Surgery



0th Day



7th Post-op Day



15th Post-op Day



30th Post-op Day



45th Post-op Day



60th Post-op Day

Radiographic observations
Pre-op and serial radiographs (0, 7, 15, 30, 45, 60 days)

showed initial anatomical alignment in all cases; Steinmann pins were radiopaque, horn pegs radiolucent. By day 7 fracture margins had blurred with early demineralisation. Day 15 showed periosteal reaction and early callus with maintained alignment. At day 30 Group A had limited feathery callus at fracture ends; Group B had more extensive callus extending ~1 cm beyond the fracture this finding aligns with the Nagaraja *et al.* (2003). By day 45 Group A showed denser callus and advancing union; Group B showed larger irregular callus and one case with cortical lysis. At day 60 Group A demonstrated near-complete union with a smaller, remodeled callus; Group B showed larger callus and increased medullary density. These observations are in concurrence with Dubey *et al.* (1993) ^[4].

A1	Before	0 th day	7 th day	15 th day	30 th day	45 th day	60 th day
AP							
ML							

B6	Before	0 th day	7 th day	15 th day	30 th day	45 th day	60 th day
AP							
ML							

Conclusion
Intramedullary horn peg effectively manage diaphyseal femoral fractures in dogs, achieving union by 60 days with excellent functional recovery and no systemic effects, comparable to Steinmann pins but with superior

biocompatibility and monitoring via radiolucency. Ideal for low-resource settings, they warrant broader adoption in canine orthopedics.

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