Indian J. Vet. Surg. 47(2): 169-171, August 2026

RESEARCH ARTICLE

ijvs

Supracutaneous locking compression plating system for the management of long bone fractures in calves

S. Dharmaceelan[1]*, N. Ramkumar[2], S. Kathirvel[3], A. Kumaravel[4], A. Kumaresan[5], S. Kokila[6], M. Vijayakumar[7] and A. Velavan[8]

Tamil Nadu Veterinary and Animal Sciences University, Chennai- 600 051 (Tamil Nadu)

[1]Professor and Head, [5]Professor, [7]Assistant Professor, Department of Veterinary Surgery and Radiology; [3]Professor and Head, [6]Assistant Professor, Department of Clinics; [4]Professor and Head, Department of Veterinary Anatomy, Veterinary College and Research Institute, Namakkal; [2]Veterinary Officer, Mecheri Sheep Research Station, Pottaneri, Salem; [8]Professor and Head, Department of Veterinary Surgery and Radiology, Veterinary College and Research Institute, Theni.

DOI No.: 10.5958/0973-9726.2026.00045.8 *Accepted: April 2026*

In the present study, the supracutaneous locking compression plating system was evaluated for the management of long bone fractures in six calves, including fractures of the radius-ulna (n=2), tibia (n=2), metacarpus (n=1), and metatarsus (n=1). All calves received preoperative antibiotic and anti-inflammatory therapy. General anaesthesia was induced using butorphanol and ketamine, while anaesthesia was maintained with a continuous rate infusion of lignocaine in normal saline. Supracutaneous fixation was performed using 5 mm locking compression plates with 10-12 holes, selected according to the fracture configuration and anatomical location. The plates were secured using self-tapping head-locking cortical screws measuring 40-80 mm in length. The screw insertion sites were covered with 5% povidone-iodine impregnated gauze, followed by application of a modified Robert Jones bandage, which was maintained until the 45th postoperative day.

Clinical evaluation was done immediately after surgery and on the 30th and 45th postoperative days. Parameters assessed included lameness grading, weight-bearing ability, pain response, and limb girth. Radiographic evaluation of fracture healing included assessment of fracture apposition and alignment, implant stability, and progression of healing activity at the fracture site. Among the six treated calves, excellent functional outcomes were observed in three cases, while one calf showed a good outcome. Poor outcomes were recorded in the two calves with tibial fractures.

Keywords: Calves, Long bone fracture, Supracutaneous plating

Long bone fractures are among the most common orthopaedic conditions encountered in ruminants. Management of these fractures in large ruminants remains challenging for veterinarians due to factors such as heavy body weight, temperament, limited soft tissue coverage, and the conical configuration of the hind limbs (Dingwall *et al.,* 1971; Gill and Tyagi, 1972). In bovines, postoperative complications such as pin tract infections and osteomyelitis are frequently encountered, particularly when postoperative care and immobilization are inadequate.

In recent years, there has been increasing interest in minimally invasive techniques for fracture management aimed at preserving biological integrity and promoting rapid healing. Biological osteosynthesis of long bone fractures can be achieved using various fixation methods, including external coaptation, external skeletal fixation, minimally invasive plate osteosynthesis (MIPO), and subperiosteal, subcutaneous, or supracutaneous bone plating techniques (Kumaresan, 2013). Among these, supracutaneous bone plating represents a modification of the type I linear external skeletal fixator, in which a locking compression plate is applied externally above the skin surface using a minimally invasive approach. The supracutaneous plating system offers several advantages over conventional bone plating and MIPO techniques, including minimal soft tissue disruption, reduced need for aggressive surgical dissection, preservation of fracture haematoma, and improved construct stability due to the use of locking screws. Additionally, this technique facilitates fracture stabilization while minimizing the risk of compromising periosteal blood supply.

Considering these potential advantages, the present study was undertaken to evaluate the clinical application and outcome of supracutaneous locking compression plating for the management of long bone fractures in calves.

Materials and Methods

A total of six clinical cases comprising two radius-ulna fractures, two tibial fractures, one metacarpal fracture, and one metatarsal fracture were selected to evaluate the efficacy of Supracutaneous Limited Contact Locking Compression Plating (SC-LCLCP) for the management of traumatic long bone fractures in calves. The calves varied in age, body size, and body weight. All calves presented with varying degrees of lameness were initially examined from a distance to assess gait abnormalities and abnormal limb mobility. Detailed clinical examination through palpation was subsequently performed to identify soft tissue injury, inflammatory swelling, pain, crepitation, exudation, and loss of limb function.

Preoperative radiographic examination of the affected limbs was carried out in mediolateral and craniocaudal projections to determine the location and configuration of the fracture and to facilitate selection of appropriate implants based on bone diameter. Supracutaneous fixation was performed using 5 mm locking compression plates (LCPs) along with head-

*Corresponding author; E-mail: vsr-vcri-nkl@tanuvas.org.in

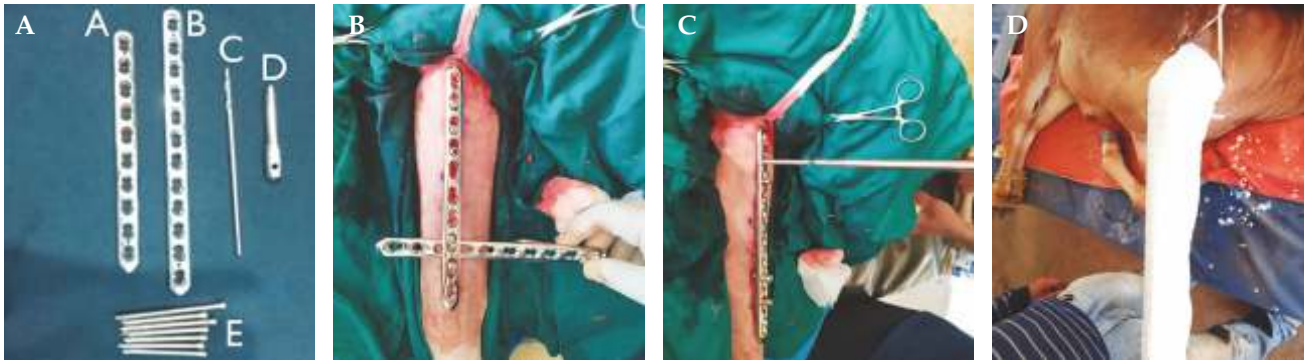

Fig. 1: Application of supracutaneous locking compression plate: (A) Instument Set (A -10 Hole LC-LCP, B - 12 Hole LC-LCP, C- 4.2 mm drill bit, D - 5 mm drill sleeve, E - 5 mm self tapping, head locking cortical screws); (B) Temporary insertion of a plate to maintain distance between implant and skin surface; (C) Application of self-tapping head locking cortical screws; and (D) Application of PVC splint over the soft bandage and completed modified Robert Jones bandage.

locking self-tapping cortical screws of varying sizes and lengths, selected according to the dimensions of the affected bone as assessed radiographically. Fracture stabilization was achieved using 5 mm locking screws of appropriate lengths and a 4.2 mm orthopaedic drill bit (Fig. 1A).

Preoperatively, all six calves were administered ceftriaxone-tazobactam (IntaCef-Tazo®; 10 mg/kg, i.v.) along with meloxicam (Melonox®; 0.2 mg/kg, i.m.). Anaesthesia was induced using intramuscular administration of butorphanol (0.02 mg/kg) followed by intravenous ketamine (2 mg/kg). Subsequently, a bolus dose of 2% lignocaine (2 mg/kg, i.v.) was administered, and anaesthesia was maintained using a continuous rate infusion of lignocaine (50 µg/kg/min) in normal saline.

The Limited Contact Locking Compression Plate (LC-LCP) was positioned supracutaneously over the fractured bone at a site with minimal muscle coverage and devoid of major neurovascular structures. A minimum of two drill holes were created in both the proximal and distal fracture fragments. To ensure a skin-to-plate distance of approximately 5–10 mm, an identical spacer plate was temporarily placed during fixation (Fig. 1B). Locking screws of appropriate length were then inserted and secured through the locking portion of the combi-holes of the plate (Fig. 1C).

Postoperatively, the screw tracts were flushed with 5% povidone-iodine solution, followed by application of povidone-iodine medicated seton dressing and external bandaging. The dressing was changed on alternate days during the first postoperative week (Fig. 1D) and thereafter once weekly until implant removal at six weeks. Restricted movement was advised for all calves for a period of three to four weeks following surgery.

Radiographic evaluation was performed on postoperative days 0, 30, and 45. Fracture fragment apposition and alignment were assessed and scored on a scale of 0–3 according to the criteria described by Cook *et al*. (1999). Fracture healing was further evaluated on postoperative days 30 and 45 using the radiographic scoring system described by Hayashi *et al.* (2008) (Fig. 2). In addition, the position and stability of the supracutaneous limited contact locking compression plate (SC-LCLCP) and locking screws were monitored throughout the observation period for evidence of implant loosening, displacement, or mechanical failure.

Results and Discussion

In the present study, two cases each of radius–ulna and tibial fractures, along with one case each of metacarpal and metatarsal fractures, were successfully managed using the supracutaneous LC-LCP technique. Medial and lateral plate placement over the tibia/radius–ulna and metacarpal/metatarsal bones, respectively, was found to be appropriate for effective application of the supracutaneous plating system. Maintaining a 10 mm distance between the skin and the implant facilitated effective postoperative management of the skin–screw interface and dressing application.

Covering the skin–screw contact areas with 5% povidone-iodine–impregnated antiseptic gauze, along with application of sterile padding and a modified Robert Jones bandage over the entire construct, helped prevent early postoperative infection. Complete and uneventful healing of all screw tracts was observed in all calves, with no evidence of discharge throughout the postoperative period. In addition, restricting limb movement for three to four weeks contributed to improved stabilization and promoted more rapid healing.

The functional outcome of the LC-LCP supracutaneous plating system was assessed based on weight-bearing ability, degree of lameness, gait pattern, pain response, and limb girth, as presented in tables 2–5. Yardimci *et al*. (2018) described a standardized protocol for evaluating outcomes following orthopedic surgery in animals, which was used as a reference for clinical assessment in the present study. The results indicated an excellent outcome in three calves,

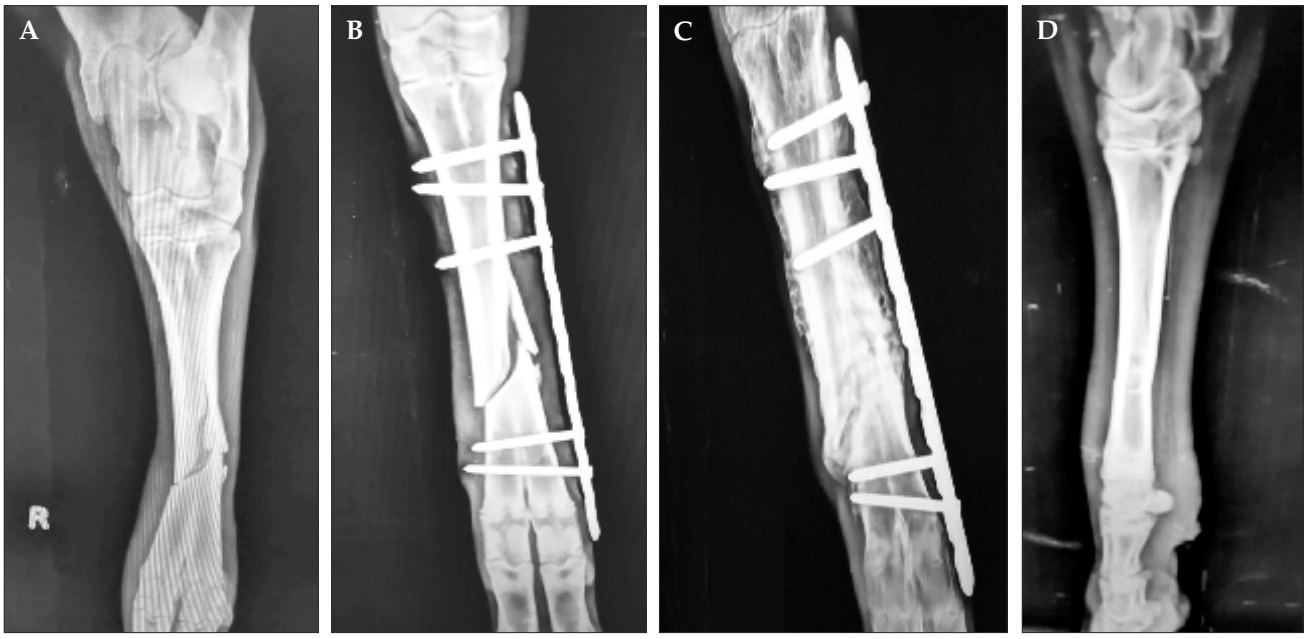

Fig. 2: Sequential radiographs of Case 6: (A) Right metatarsal transverse fracture- mediolateral view; (B) Immediate postoperative day- dorsoplantar view; (C) 30th postoperative day- dorsoplantar view; and (D) 45th postoperative day- mediolateral view.

characterized by full weight bearing, absence of visible lameness, functional use of the operated limb, and no palpable pain. These successful outcomes were observed in cases involving radius–ulna and metatarsal fractures. A good functional outcome was observed in one calf with a metacarpal fracture. However, the supracutaneous plating system failed in two calves with tibial fractures, as the plates were unable to adequately maintain stabilization of the fracture fragments. In these cases, loss of fixation with distraction of the fracture site occurred during the first postoperative week. Overall, supracutaneous plating produced satisfactory clinical outcomes in most cases, which can be attributed to its simplicity, ease of application, and minimally invasive nature. The technique provided adequate stabilization of fracture fragments, resulting in improved patient tolerance, enhanced healing, and earlier return of limb function, including mobility and weight-bearing capacity.

In conclusion, 5 mm locking compression plates (LCPs) with 10-12 holes, used in combination with 5 mm self-tapping head-locking cortical screws of 40-80 mm length, were found to be suitable for supracutaneous application in radius-ulna, metacarpal, and metatarsal fractures in calves up to 10 months of age weighing up to 85 kg. However, the technique was not found to be adequate for the stabilization of tibial fractures.

References

Cook, J.L., Tomlinson, J.L. and Reed, A.L. 1999. Fluoroscopically guided closed reduction and internal fixation of fractures of the lateral portion of the humeral condyle: Prospective clinical study of the technique and results in ten dogs. Vet. Surg. **28**: 315–321.

Dingwall, J.S., Duncan, D.B. and Horney, F.D. 1971. Compression plating in large animal orthopedics. J. Am. Vet. Med. Assoc. **158**: 1651–1657.

Gill, B.S. and Tyagi, R.P.S. 1972. A study on the fracture repair and management of long bones in large animals with special reference to external fixation. Indian Vet. J. **49**: 386–393.

Hayashi, A.M., Matera, J.M., Sterman, F.D.A., Muramoto, C. and Cortopassi, S.R.G. 2008. Evaluation of electroacupuncture in bone healing of radius-ulna fracture in dogs. Braz. J. Vet. Res. Anim. Sci. **45**: 339–347.

Kumaresan, A. 2013. Plate osteosynthesis of diaphyseal fractures of radius, metacarpal, tibia and metatarsal using LC-DCP in small ruminants. PhD Thesis, Tamil Nadu Veterinary and Animal Sciences University, Chennai (Tamil Nadu), India.

Yardimci, C., Onyey, T., Inal, K.S., Ozbakir, D.B. and Ozak, A. 2018. Management of complete talocrural luxations by selective talocrural arthrodesis using hybrid transarticular external skeletal fixation in dogs. Vet. Comp. Orthop. Traumatol. **31**: 291–297.