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Management of compound fracture of distal long bone in cattle by circular external skeletal fixation technique

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Abstract:

Compound fractures of the distal long bones in large ruminants are difficult to manage because of heavy body weight, anesthetic risks, and high costs. Circular external skeletal fixation (CESF) provides better stability and flexibility for treating such fractures. The present clinical study evaluated the efficacy of CESF in four cattle with traumatic compound fractures. CESF was applied under sedation combined with local anesthesia. Constructed CESF frames were mounted around the injured bone and aligned cylindrically, maintaining at least 2 cm clearance between the skin and the ring. Transfixation wires were inserted in caudomedial–craniolateral and craniomedial–caudolateral directions, beginning with the most proximal and distal rings, followed by the intermediate rings, and the nuts were secured on the slotted bolts. Three animals showed partial weight-bearing within 15 days. Progressive callus formation led to complete functional recovery within two months. This study demonstrates that the circular external fixator is strong enough to counteract compressive and bending loads and is suitable for managing compound fractures in large animals.

Keywords: Cattle, compound fractures, long bones, circular external skeletal fixation, pin tract infection

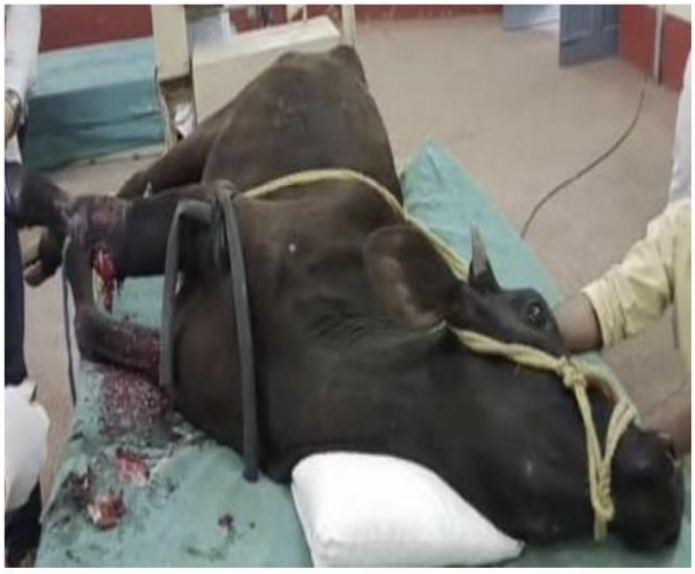
Introduction:

Fractures of long bones in large ruminants constitute a significant proportion of musculoskeletal disorders and are typically acute traumatic injuries requiring urgent surgical intervention. Management of these fractures is particularly challenging due to the animals' large body size and the need for implants strong enough to withstand their considerable weight (Lozier et al., 2018; Jennes et al., 2025). Unlike in several countries where large animals with fractures are often culled or slaughtered, in India such practices are restricted by socioeconomic and religious considerations, necessitating therapeutic intervention. Epidemiological data indicate that metacarpal and metatarsal fractures account for nearly 50% of long bone fractures in large ruminants, followed by tibial fractures (12%), fractures of the radius and ulna (7%), and humeral fractures (5%), whereas femoral fractures are relatively rare (Anderson & James, 2008; Kumar et al., 2022). Overall, more than 68% of fractures occur below the elbow joint in the forelimb and the stifle joint in the hind limb. Owing to the heavy body weight of these animals, fractures of the distal long bones are often compound and comminuted, which further complicates treatment (Aithal et al., 2010).

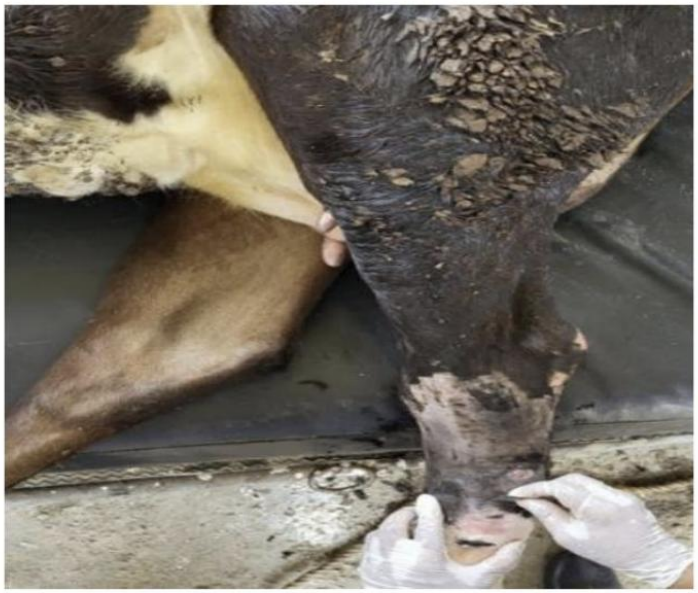
Various fixation techniques are used in large animals, ranging from external methods such as plaster casts and modified Thomas splints to internal approaches like intramedullary pinning, bone plating, interlocking nailing, and external skeletal fixation, including linear, epoxy, and circular designs. External fixation alone is generally unsuitable for compound fractures, whereas internal fixation provides better stability but is often avoided in large ruminants due to economic constraints, anaesthetic risks, and challenges in maintaining asepsis (Lozier et al., 2018). External skeletal fixators (ESFs) of various designs like epoxy, linear, circular, and hybrid have been used successfully in fracture management (Singh et al., 2007). Among them, circular external skeletal fixation offers several advantages, including superior mechanical stability, effective fragment stabilization, and post-operative frame adjustability to permit translation, rotation, or angulation corrections (Lewis et al., 1998; Aithal et al., 2007). The present clinical study evaluated the efficacy of circular external skeletal fixation in the treatment of distal long bone fractures in four cattle.

Materials and Methods:

Four clinical cases of compound distal long bone fractures in cattle were presented to the Department of Veterinary Surgery, Bihar Veterinary College, Patna. The history revealed traumatic injuries affecting the forelimb in one animal and the hind limb in three animals. Clinical examination identified a compound fracture of the distal radius–ulna in one case (Fig. 1A), the distal metatarsal in one case (Fig. 1B), and the distal tibia–fibula in two cases. Radiographic evaluation confirmed the diagnosis, revealing an overriding oblique fracture of the distal radius–ulna (Fig. 2A), an oblique fracture of the distal metatarsal region (Fig. 2B), and oblique distal tibia–fibula fractures in the remaining two animals.

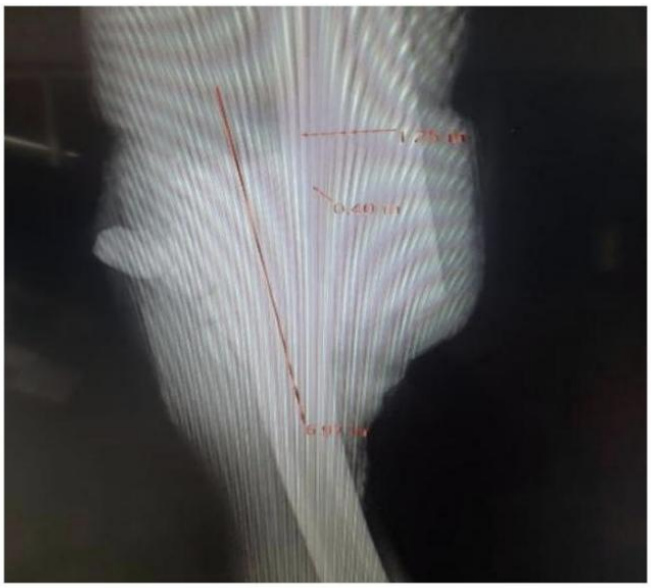


A

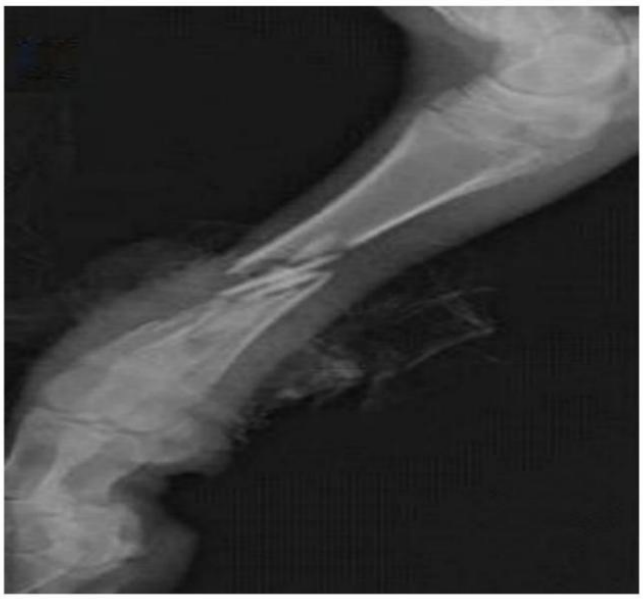


B

Fig. 1. A & B Clinical case dital long bone fracture



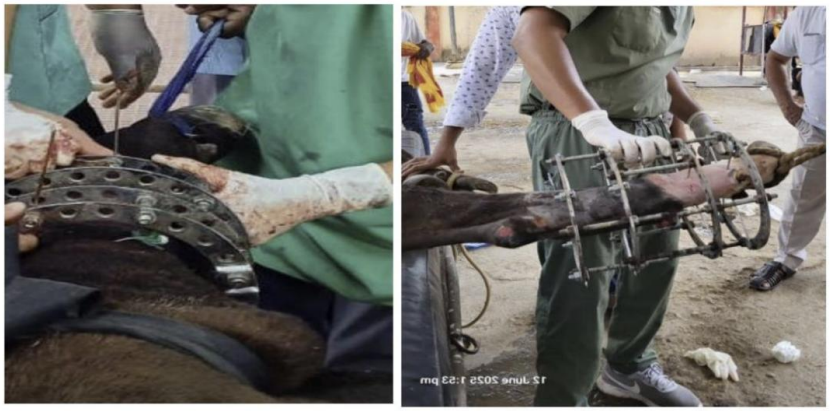
A



B

Fig.2 A & B. Radiograph of clinical cases

Following confirmation, surgical management using a circular external skeletal fixator (CESF) was planned to preserve limb function and ensure survival. The CESF frame was constructed based on the radiographs of the fractured bones to ensure proper alignment and to maintain the range of joint motion. Sedation was achieved with butorphanol and midazolam, followed by a brachial flexor block and local intravenous anaesthesia with 2% lignocaine for the radius–ulna fracture, and spinal anaesthesia for the metatarsal and tibia–fibula fractures. The animals were positioned in lateral recumbency, and the surgical site was prepared aseptically. The wounds were debrided, and the fractured bone ends were realigned into proper apposition. The pre-constructed CESF frame was mounted around the injured bone and aligned cylindrically with the limb axis at the centre, maintaining a minimum clearance of 2 cm between the skin and the ring. Transfixation wires were inserted in caudomedial–craniolateral and craniomedial–caudolateral directions, beginning with the most proximal and distal rings, followed by the intermediate rings (Fig. 3A & B). The nuts were secured on the slotted bolts, and the excess wire length was cut and bent inward. Postoperatively, the animals were treated with amoxicillin–sulbactam at 7 mg/kg body weight intramuscularly for seven days and meloxicam with paracetamol at 0.2 mg/kg body weight intramuscularly for three days. The owners were advised to perform regular antiseptic dressing of the wounds and to flush the pin insertion sites with povidone-iodine lotion.



A B

Fig. 3. A & B, Application of CESF

Results

Three animals showed partial weight-bearing within 15 days (Fig. 4A & B); however, one animal remained in lateral recumbency and succumbed after seven days. In the surviving animals, the open wounds began to heal gradually, with accelerated healing observed following the application of collagen gel. Three animals achieved complete recovery within two months without major complications, and full wound healing was obtained within 60 days (Fig. 4C & D). Pin-tract infection occurred in all cases; however, it was mild and resolved with regular antiseptic dressing and flushing. Radiographic evaluation demonstrated good fracture alignment and progressive callus formation in the surviving cases. By 60 days, both clinical and radiographic findings confirmed satisfactory bone union, and the external fixators were removed without complications.

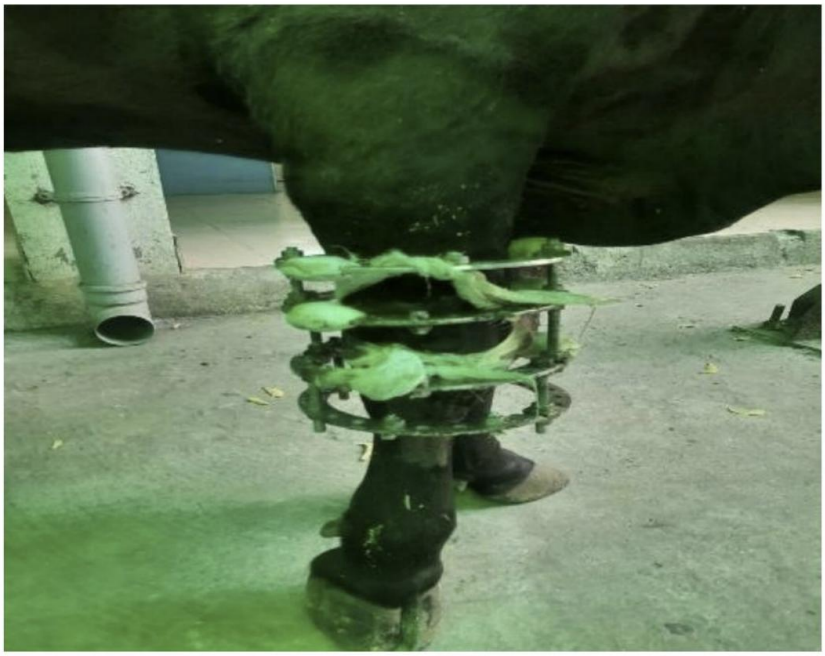


Fig4. A

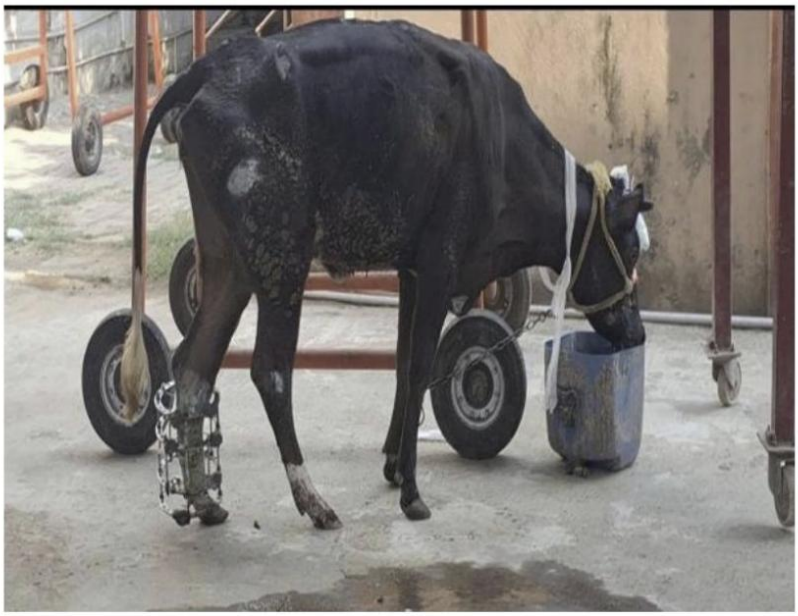


Fig4. B.

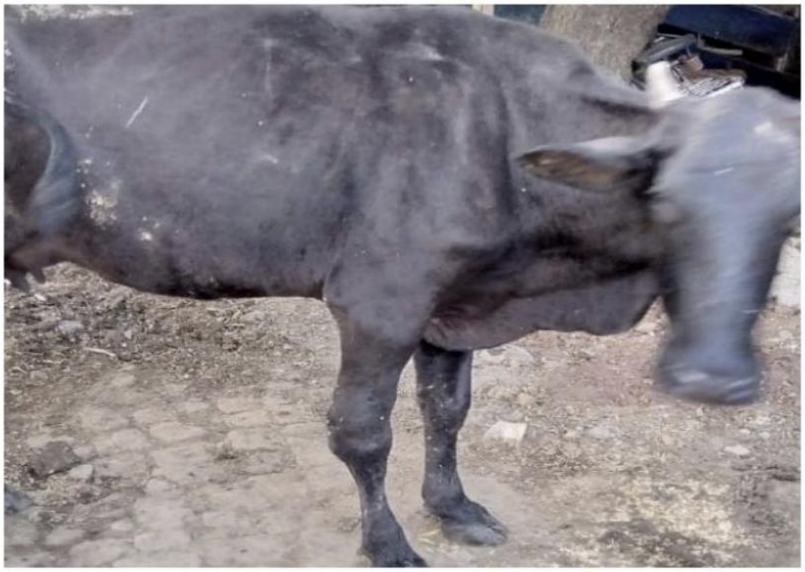


Fig4. C

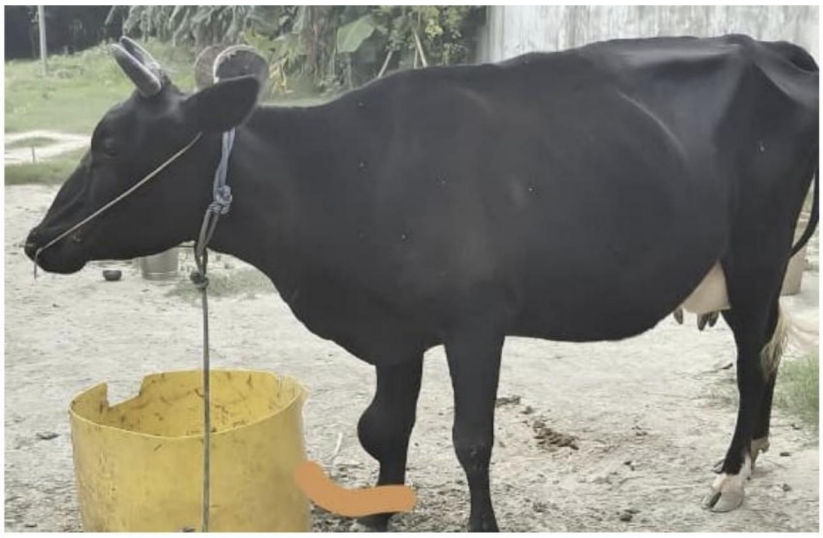


Fig4. D

Fig. 4. A & B weight wearing after 15 days, Fig. C & D after recovery

Discussion:

For the successful management of compound long bone fractures in large animals, the fixation technique should provide adequate stability and rigidity, be cost-effective, simple to apply, and easy to manage during postoperative care. Circular external skeletal fixation, being strong enough to counteract compressive and bending loads, is suitable for the managing such fractures in large animals. In the present study, circular external skeletal fixation (CESF) was applied for the stabilization of compound fractures of the distal long bones in cattle, and three of the four animals achieved complete recovery. These findings are consistent with earlier reports that highlighted the biomechanical superiority of circular fixators in large animals (Aithal et al., 2007; Lewis et al., 1998).

The gradual healing of open wounds and the faster recovery observed following collagen gel application demonstrate its efficacy in enhancing granulation tissue formation and epithelialization (Shetty et al., 2014). Pin-tract infections were observed in all animals, a complication frequently reported with external skeletal fixation (Singh et al., 2007; Kumar et al., 2022). However, these infections were mild and were successfully managed with regular antiseptic dressing, in agreement with earlier studies that emphasized the role of meticulous pin-site care in reducing morbidity (Aithal et al., 2010). One animal remained in lateral recumbency and died after seven days, highlighting an important limiting factor in large animal fracture management (Lozier et al., 2018; Jennes et al., 2025). Despite this, the overall recovery rate supports the clinical applicability of CESF in

field conditions where other fixation techniques may be economically or technically impractical.

Conclusion:

Circular external skeletal fixators are economical to fabricate for use in large animals and provide sufficient mechanical strength to counteract compressive and bending forces. Their stability, adaptability, and effectiveness make them a suitable choice for the successful management of compound long bone fractures in large ruminants.

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