External Skeletal Fixation of Fractures in Cattle

Susan R. Vogel, DVM, MS[a], David E. Anderson, DVM, MS[b,*]

KEYWORDS

• Cattle • Fracture • External fixator • Pin cast

KEY POINTS

- External skeletal fixation (ESF) is a versatile method for rigid immobilization of long bone fractures in cattle.
- Traditional ESF devices may be used in young calves for clinical management of open fractures.
- Transfixation pinning and casting is an adaptation of ESF principles to improve clinical management of selected fractures.

Cast immobilization of fractures is most often chosen in ruminants because the most common fractures encountered can be appropriately treated with this form of external coaptation and because casts offer a reasonable economic treatment. Complications of casting include one or more of the following: muscle contracture, loss of range of motion of joints because of joint capsule and ligament contracture, reduction in articular cartilage quality and health because of prolonged immobilization, cast ulcers, impingement of soft tissues and vasculature, creation of open wounds that may communicate with the fracture, malalignment of the fracture, malunion of the fracture, delayed union of the fracture, and prolonged convalescence. Depending on the type of ESF used, these complications can be prevented or minimized. When cast immobilization is not appropriate or does not provide optimal management of fractures, other modalities must be considered. Casts cannot adequately immobilize fractures proximal to the distal radial physis or the distal tibial physis. Also, soft tissue injuries and open fractures may not be managed optimally by use of casts, splints, or splint-cast combinations. ESF presents a better option for stability and healing of fractures in many cases based on fracture configuration, soft tissue injuries, or open fractures. Usually, ESF is used in purebred animals, show animals, or other cattle of high perceived economic value.

[a] Elanco Animal Health, 2500 Innovation Way, Greenfield, IN 46140, USA; [b] Large Animal Clinical Sciences, College of Veterinary Medicine, University of Tennessee, 2407 River Drive, Knoxville, TN 37996, USA
* Corresponding author.
E-mail address: David.anderson@utk.edu

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ESF refers to the stabilization of a debilitating musculoskeletal injury (typically fractures and also joint luxation or tendon rupture) using transfixation pins (or transcortical pins) and any external frame connecting the pins and spanning the region of instability. The goal of ESF is to provide a sustainable, comfortable means to return the patient to weight bearing (or function) as soon as possible after surgery, to maintain normal joint mobility, if possible, and to provide an optimal environment for osteosynthesis and wound healing. There are 3 main types of ESF used in ruminants: (1) ESF using pins, clamps, and sidebars; (2) transfixation pin casts (TPCs) in which the fiberglass casting tape replaces the function of the clamps and sidebars; and (3) hanging limb pin casts in which the pins are only placed proximal to the fracture and a full limb cast is placed including the foot.

ADVANTAGES

ESF provides early return to function of the affected limb, management of soft tissue wounds on the limb, preservation of local blood flow to the fracture site, preservation of bone stimulatory proteins that exude into the fracture site at the time of initial injury, diversity in design for comminuted fractures, ease of implant removal after clinical union of the fracture, and relatively few complications resulting from the implants. ESF can be applied to most of the long bones. Transarticular application of external fixators may be used in the presence of severe soft tissue trauma or severe comminution of the proximal or distal end of the affected bone, and for arthrodesis or ankylosis of joints.

DISADVANTAGES

Disadvantages of ESF are suboptimal fracture reduction and poor anatomic alignment, absence of interfragmentary compression, less-rigid stabilization of the affected bone compared with bone plates, increased postoperative management compared with bone plates or casting, pain associated with micromotion at the pin-bone interface, and potential failure of the implants before clinical union of the fracture. Whenever possible, transcortical pins should be inserted between muscles and through facial planes. Pins placed through major muscle groups may result in pain and reduced usage of the affected limb.

TYPES OF ESF

Transfixation Pinning and Casting (TPC)

The most important goal of ESF is to return the animal to full weight bearing within a time frame that minimizes hindrance of limb use. Transfixation pin casting utilizes ESF pins that are incorporated into fiberglass casting material. These pins typically are inserted as *full* pins, meaning that they pass through the limb and are positioned so that the pin exits both sides of the limb (**Fig. 1**). Full pins offer the most stable construct with ESF by distributing force symmetrically across the pin. Most often, 2 to 3 positive profile pins are inserted proximal to the fracture and separated by a distance equal to 6 times the diameter of the pin (eg, two 6-mm-diameter pins should be separated by 36 mm of bone).[1] Positive profile pins are pins having threads that are greater in outer diameter than the shaft, or core, diameter of the pin. Positive profile pins are recommended because of the stronger bone-implant interface between the threads and cortical bone when compared with smooth pins.[2]

One advantage of TPC is that the distance between the bone and frame (cast) is minimized. The rigidity of the frame and bending resistance of pin are determined,