Management of long bone fractures by free-form external skeletal fixation using epoxy putty in sheep and goat

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Journal of Livestock Science (ISSN online 2277-6214) 9: 51-55
Received on 18/8/2017; Accepted on 23/3/2018

Abstract

Six small ruminants presented to Campus Veterinary Hospital, College of Veterinary Science, Rajendranagar were diagnosed to have long bone fractures. Physical examination and Radiography aided in diagnosis. In all the cases the fracture was stabilized by application of free-form external skeletal fixation using epoxy putty under sedation with Xylazine Hydrochloride and Intravenous regional anesthesia with 2% Lignocaine Hydrochloride. Fracture healing was assessed periodically by taking plain radiographs. Swelling and discharges from the tracts were recorded during the first three postoperative days in all the treated cases. Complete weight bearing was observed by 34.6± 10.3 days.

Key words: external skeletal fixation; long bone; epoxy putty; small ruminants

Introduction

Fractures of long bones are common in sheep and goats and require either conservative management or surgical interference (Aithal et al 1998). Major constraints in treating fractures of these animals are the cost of the implants and costly postoperative care. Therefore External Skeletal Fixation (ESF) is gaining popularity as it is less invasive, requiring minimal equipment (Harari *et al.*, 1998) and relatively easy to perform. Though the linear ESF serves good for many long bone fractures it has some limitations like no potential for using smaller or larger pins as the transfixation pins size depends on the size of clamps used. Free-form ESF allows the transfixation pins placed in the fracture fragments to be connected with Epoxy compound and Acrylic material rather than clamps and metallic connecting rods. In the present study management of long bone fractures in sheep and goat by free-form external skeletal fixation using epoxy putty was discussed.

Material and Methods

The present study was carried out in six small ruminants presented to the surgery ward of the college clinics with long bone fractures. Out of six animals two are sheep (n=2) and four are goat (n=4). The type of fracture and its severity was assessed by physical examination of the animal and radiography of the affected limb. The anamnesis of the animals under the study is as follows,

Case No.	Species	Sex	Age (months)	Breed	Bone involved	Type of fracture	Etiology	ESF removal
1	Goat	F	3 M	N.D	Tibia	Oblique	Fall from Height	64
2	Goat	F	4 M	Jamunapari	Metacarpal	Oblique	Automobile Accident	59
3	Sheep	M	2M	Nellore	Metacarpal	Transverse (Fig-1)	Automobile accident	56
4	Goat	F	2 M	Jamunapari	Tibia	Oblique	Fall_from height	50
5	Goat	M	2.5M	N.D	Metacarpal	comminuted	Automobile Accident	42
6	Sheep	M	1.5 years	Nellore	Radius-ulna	Oblique	Physical Trauma	63

All the animals were given a first aid for the fracture on the day of their presentation and advised 12 hours fasting prior to surgery. Temporary stabilization of the fracture site was done by application of Robert jones and reinforced Robert jones bandage, till the date of surgery. All the animals were prepared for aseptic surgery and were sedated with intramuscular injections of Xylazine hydrochloride @ 0.05 mg/Kg body weight. Regional anesthesia was achieved by injection of 2% Lignocaine hydrochloride at the dose rate of 2.5mg/Kg body weight into cephalic and saphenous veins depending on the limb affected with a preplaced tourniquet proximal to the area of administration.

The fracture reduction and surgical procedure was performed in lateral recumbancy in all the cases except one where it was performed by hanging limb method. Fracture fragments were reduced to their normal anatomical positions by application of traction and counter traction. The pins were drilled into the two cortices of the bone by using a low speed, high torque power drill (150 to 400rpm) from medial aspect to lateral aspect of bone after giving a small stab incision to the skin at their point of entry of pin. Two proximal and two distal pins were placed in four cases at an angle of 70º between the two pins in each fragment where as in two cases the distal fragment was placed with a single pin. The most proximal and distal pins were drilled first then followed by others. Following the placement of proximal and distal pins, they were connected to an aluminum rod with the help of orthopedic wire (Fig-2) as followed by Kumar et.al., (2008) Thereafter, the position of the aluminum rod was used to determine the position and orientation for the drilling of the remaining transfixation pins. The fracture site was reassessed for satisfactory reduction and alignment.

Uniform black colour dough was produced by kneading the hardener and the base of the epoxy compound (Fig-3). The dough was placed in small quantities on the half pin-connecting pin interface and moulded firmly around the pins by digital pressure. Once the hardening started to begin the fixation pins were cut close to the column (Fig-4) and the protruding ends of these pins and connecting bar were covered with epoxy.

Postoperatively, the pin-skin interface was cleaned with 5% povidone iodine solution and covered with povidone iodine soaked sterile gauze pads (Fig-5). The implant was covered with cotton pad on medial aspect and applied a padded bandage to avoid injury to contra lateral limb. Ampicillin-Cloxacillin (AC-VET® FORTE) was

		
Fig.-1:Radiograph showing transverse fractures of metacarpal	Fig-2: The proximal and distal pins connected by 6 mm aluminum rod using orthopedic wire	Fig -3: Photograph showing commercially available epoxy putty (M-Seal)
		
Fig-4: Transfixation pins were cut close to the column	Fig-5: The pin-skin interface covered with sterile gauze pads soaked in 5% povidone iodine solution	Fig-6: Cutting the pins close to the Epoxy connecting column
		
Fig-7: Transfixation pins pulled out using a needle holder	Fig-8 Radiograph showing proper placement of the fixator, apposition and alignment on 15th post-op. day	Fig-9: Radiograph showing fracture healing of metacarpal treated with free form ESF using epoxy putty on 45th post-operative day respectively

administered parentally at the dose rate of 10 mg / kg weight for five days. Meloxicam at the dose rate of 0.25 mg/kg body weight was administered parentally for three days. The pin tracts were dressed with povidone iodine on alternative days for the first ten days. The owners were advised to restrict the activity of the animal until clinical union was observed. Plain Anterio-Posterior radiographs of the operated bones were obtained immediately after surgery and on the 15th, 30th, 45th days, and whenever needed on later dates to access the progress of bone healing.

Following clinical and radiographic union of the fractured bone the External Skeletal Fixators were removed by cutting the pins close to the Epoxy column (Fig-6) and pulling the transfixation pins with a needle holder (Fig-7). All the transfixation pins in animals were removed at once without any staged disassembly. The pin tract sites were cleaned with 5% povidone iodine solution and a sterile dressing pad was applied with a protective bandage for one week.

Results and Discussion

The radiographic healing was recorded on 15th (Fig-8), 30th, 45th (Fig-9) postoperative days recorded in all the animals. One animal with closed tibial fracture showed partial weight bearing from 1st post-operative day and achieved complete weight bearing by 25th post- operative day. The maximum time taken for partial weight bearing in this group was recorded as 24 days. Complete weight bearing was observed between 5th and 62nd day with a mean of 34.6±10.3 days. The mean lameness scores in the animals were 2±0.26, 2±0.37, 1.67±0.33 and 2.67±0.5 at the end of 1st, 2nd, 4th and 6th week of observations respectively.

All the six animals, had well tolerated the external skeletal fixator assembly. The swelling and discharges from the tracts were observed initially for the first three post-operative days and reduced gradually by the end of first week of postoperative period. Subsequently, during dressing of the operative site, the wounds of the surgical incision (limited open approach) and the pin tract were found dry and healthy during entire observation period. Implants were found to be stable in all the cases. When the transfixation pins were cut for removal of the fixator, all the proximal pins were found to be loose, although the external skeletal fixators were firmly in place in all the animals. The external skeletal fixator was removed in the animals between 42 days to 64 days, with mean time of 58.3±6.26 days. Slight healthy discharges from all pin insertion sites were observed after removal of fixator in all the treated animals. This discharge was resolved in within three days by routine dressing of the wounds.

It was observed from the results of the present clinical study that automobile accidents were the most common cause of fractures in small ruminants followed by physical trauma and fall from a height. Physical trauma, in this context, referred to violence, i.e. the sheep and goats being beaten either by the owners or strangers. Aithal et al. (1998) and Dandekar (2007) also made similar observations. However, Kushwaha et al. (2011) stated that fall from a height or jumping was the most commonly found exciting cause of fractures in sheep and goats.

The patient preparation and anaesthetic protocol followed for the surgery was found satisfactory in all the animals for management of fracture in the present study. Hall et al. (2001), Ramanathan et al. (2006) and Kumar et al. (2008) also recommended similar patient preparation and anaesthetic protocols for fracture management in sheep and goats.

Thoroughly kneaded epoxy putty was first applied in small quantities at the junction of pin and aluminum rod and later throughout the length around the aluminum rod. The results indicated that it required about 40 to 75 minutes for hardening of the epoxy compound. The fracture fragments were kept in alignment for about half an hour after surgery by holding the limb manually to avoid loss of reduction till the hardening of epoxy putty connecting bar. Similar observations were made by Roe and Keo (1997).

Cleaning the transfixation pin-skin interface with normal saline and dressing with 5% povidone-iodine pads resulted in clean and dry pin-skin interface. Harari et al. (1998) suggested daily cleaning with dilute antiseptic solutions like chlorhexidine and povidone-iodine post-operatively to treat pin tract drainage. Ozak et al. (2009) also suggested the use of antibiotic spray for possible pin tract infections during convalescence period. Post-operative swelling of the affected limb observed for first 3 to 5 days in all the animals was considered a normal consequence of the surgical procedure. It also suggested that this swelling should be considered clinically inconsequential if it is not accompanied by discharge of pus or foul smelling discharges.

In all the animals of the two groups, loosening of the proximal most pin accompanied by healthy discharge at the time of ESF disassembly was evident due to excessive local stress on the upper most transfixation pin leading to bone resorption. Kraus (2003), Beck and Pead (2003), Gemmill et al. (2004) and Corr (2005) also made similar observations.

In the present study epoxy putty was used as the connecting bars and it was observed that the ESF fixators were firmly in place, holding the limb and the fracture site safely together. Loosening of the proximal most pin was found in all the animals with less effect on the stability of ESF construct. Kraus et al. (2003) recognized that a good clinical result can sometimes be achieved in spite of a rapidly loosening and failing fixator. Johnson et al. (1989), Lewis et al. (2001) and Fox (2008) also opined that pin loosening was normal progression with external skeletal fixation. Kraus et al. (2003) managed similar complications by placing additional pins and connecting bars to enhance the strength and rigidity of the construct. Finally, it was concluded that epoxy putty is suitable for free-form external skeletal fixation for management of long bone fractures in sheep and goats.

Acknowledgement- The authors are thankful to Dr KBP Raghavender, director of research, SPVNR TVU for his kind guidance and help.

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