Chapter 1: INTRODUCTION

Humeral fractures occur infrequently in cattle accounting for less than 5% of all types of fracture and 18% of all long bone fractures (Rakestraw, 1996). These fractures are typically spiral or oblique through the diaphysis with different degrees of communication (Tulleners, 1986). They may occur close to the radial nerve, which induces a considerable risk of permanent neurological damage (Ferguson, 1997).

Several treatment options have been proposed for management of humeral fracture in ruminants. These include stall rest, intramedullary pins, interlocking nails, and plates (Hickman *et al.*, 1957). Euthanasia has often been recommended for adults because of the poor prognosis (Tulleners, 1986). Method of treatment depends on the size, age, temperament and economic value of the animal as well as the type and location of the fracture and past experience of the surgeon.

Instability and displacement without contact of the proximal and distal fragments decrease the probability of a favorable result (Pentecost *et al.*, 2016). Internal fixation techniques using plates and intramedullary pins have been used successfully for the repair of humeral fractures in cattle (Rakestraw, 1996). However, plate fixation is rarely done in cattle, because it requires expensive implants and equipment, specialized surgical facilities, and anesthetic support for orthopedic surgery (Langley-Hobbs *et al.*, 1996). Plate fixation is also difficult in cattle due to short length and irregular surface of humerus and a heavy muscle mass surrounding the bone (Rakestraw, 1996). The intramedullary pin technique is less invasive than plating (Saint-jean and Hall, 1987). Intramedullary pins cannot be used when there is extensive communication, and are best suited for oblique fractures or, in combination with cerclage wires, for long oblique fractures (Markel *et al.*, 1988).

Intramedullary fixation techniques using Steinman pins, or kuntschner clover leaf nails have all been successful in repair of humeral fractures in large animals (Greenough *et al.*, 1972). Pin diameter must be carefully chosen not to exceed a safe pin hole size in relation to the diameter of the bone. Generally, pin size should not exceed 20% of the diameter of the affected bone. Drilling a hole equipment to 20% of the bone diameter caused a 34% reduction in the torsional strength of the bone (Edgerton *et al.*, 1990).

An advantage of intramedullary implants over plating is that the difficult surgical approach necessary to expose a sufficient amount of the diaphysis of the humerus for plate application is avoided in favor of a more limited surgical approach to the diaphysis for debridement and fracture reduction. Of these three intramedullary implants, Steinman pins are most commonly used in ruminants. Rush pins are difficult to place correctly and are inappropriate in comminuted or open fractures. Obtaining adequate fracture reduction and alignment for insertion of the intramedullary pins is often not possible without first exposing the fracture site. A lateral approach is made to the humerus for debridement and fracture reduction (Milne and Turner, 1974). The fracture is reduced using bone distractors or obstetric chains placed above and below the fetlock and attached to a winch. Once the fracture is reduced, the Steinman pin(s) is inserted normograde into the medullary cavity at the fossa between the cranial and caudal aspects of the greater tubercle. The pin(s) should be driven into the medial side of the humeral condyle.

A single intramedullary Steinman pin does little to prevent rotational instability and collapse of oblique fractures. Multiple pins create frictional forces between the pins and cortical surface, preventing rotational instability. Cerclage, by compressing the fracture, decreases rotational instability (Markel *et al.*, 1988). For repair of humeral fractures in large ruminants, both multiple pins and cerclage are recommended to strengthen the repair.

Pin migration due to an unstable fracture repair with subsequent nonunion is the most common complication of this technique of fracture fixation in small animals (Smith, 1985). Stack pinning and cerclage fixation, by increasing the stability of the repair, should decrease the incidence of nonunion caused by pin migration. The pins can still migrate, but the remaining pins and the cerclage fixation should provide enough stability for the fracture to heal. The pins should be cut as they migrate to prevent the protruding ends from traumatizing the adjacent soft tissue. The objective of the present study was to evaluate the femur fractures and treatment options in cattle by intramedullary pinning fixation.

Chapter 2: Materials and Methods

2.1. CASE HISTORY:

A 1-year old yearling bull weighting 63 kg was presented to the S. A. Quadery Teaching Veterinary Hospital (SAQTVH), in Chattogram Veterinary and Animal Sciences University (CVASU), Chattogram with a history of injury in the left fore limb in the position of humerus bone with loss of weight bearing capacity.

2.2. CLINICAL EXAMINATION:

A. By physical examination:

a. Close inspection:

Firstly, close inspection done carefully to observe the presenting signs and recorded

b. Direct palpation:

By finger tips at the affected site were palpated and felt broken of humerus bone in its original position

B. By imaging examination:

Radiography (X-ray):

The yearling bull was diagnosed with oblique mid diaphyseal fracture of left humerus by X-ray

2.3. Restraining and anesthesia:

Both physical and chemical methods were used to restrain the bull. The bull was sedated using Diazepam at (0.5mg/kg body weight) intravenously and use Lidocaine HCL at (6mg/kg body weight) subcutaneously.

2.4. Surgical management:

The patient was taken to the operating room, placed under anesthesia and remained in Operation Theater (OT) table. The entire left fore limb was prepared for aseptic surgery by shaving and mopping using alcohol and povicep on the skin. Following draping a craniolateral approach to the humerus was used to expose the fracture fragment. An incision along the skin of the affected area was made and separated the subcutaneous tissue and superficial fascia. The humerus bone was covered and supported by the four types of muscles, Biceps brachii, Brachiocephalicus, Deltoid and Triceps brachii muscles. So those muscles were then incised taking care to avoid major blood vessels. Following separation of the muscle by blunt dissection, the layers of muscles were incised and then guided a cut by a finger placing under the bone fracture. Then the partial of broken bone was removed by bone curette and bone cutting forceps. The bone was placed in its normal position by Hohman retractor bone holding forceps. Then the proximal bone fragment was accelerated and an intramedullary pin which almost fills the diameter of the medullary canal was inserted into the proximal fragment by bone drilling machine and the pin was withdrawn from the pore and skin after making stab incision at the humeral greater tubercle. The fracture was decreased and the proximal and distal bone fragments are aligned and the pin was then inserted within the distal fragment and anchored at the distal extremity thus immobilizing the fracture. The diameter of the intramedullary pin was dictated by the size of the patient. After conducting the open reduction, the muscle tissues were apposed and the fascia later was sutured in simple continuous suture by catgut (no.1). The subcutaneous tissue was apposed using catgut (no.1) in a simple continuous pattern and the skin was apposed using silk by cross mattress suture. The suture line was mopped by povidone iodine. During surgery 5% dextrose in normal saline (400ml) was administered intravenously. Then a bandage was applied in the leg to immobilize the affected area. The average time for setting up an intramedullary pinning fixation was 2 hours.

2.5. Post-operative care:

A course of antibiotic and antihistaminic drug therapy was administered for 7 days. The yearling bull was given antibiotic drug (Inj. Streptopen^{R}) and antihistaminic drug (Inj. Alerin ^{R}). Also given analgesic drug (Inj. Kynol vet^{R}) at 24 hours interval for 3 days. The wound was cleaned daily by antiseptic ointment (Oint. Viodin^{R}). Skin sutures had been removed on 14^{th} day of operation.

Chapter 3: Results

The cattle tolerated the intramedullary pin well and fracture healed completely. During the postoperative clinical and radiological examinations, no changes in the configuration of the intramedullary pin, or bone lysis were observed. There was no evidence of deformity due to excess weight bearing and no evidence of damage to nerves or blood vessels. No major complications such as osteomyelitis was encountered. The cattle had operated limb touching the ground by the 7^{th} day and the cattle began weight bearing after 1month.

Chapter 4: Discussion

The management of bovine fractures is complicated by circumstances and expectations, and the significant influences of economic factors. In their favor, most cattle are cooperative patients that usually spend a significant amount of time lying down during convalescence which prevents overloading of bone implants (Crawford and Fretz, 1985). Cattle also have enhanced potential for bone healing due to increased vascular density in their bones and a well-developed osteogenic layer in the periosteum. They are also unlikely to suffer problems in the unaffected limbs due to increased weight bearing (St-Jean and Anderson, 2014). In the current case, prompt stabilization of the fracture by intramedullary pinning at the time of occurrence improved prognosis by preventing a closed fracture from becoming open, preventing further fracture fragmentation and reducing eburnation of the fracture ends (Pentecost *et al.,* 2016). Reported internal fixation techniques in cattle include intramedullary pinning (Nichols *et al.,* 2010),clamp rod internal fixators (Gamper *et al.,* 2006) and of DCPs (St-Jean and Anderson, 2014). Internal fixation techniques are more surgically invasive and expensive, but they allow optimal fracture reduction and interfragmentary compression, and greater biomechanical stability compared with external fixation techniques (St- Jean and Anderson, 2014).

In a research by (Inas *et al.,* 2012) argue that the intramedullary pinning offers high quality balance for long bones, so it offers great biomechanical surroundings for fracture recovery. Intramedullary devices have several advantages in fracture treatment, including restoration of bony alignment and recovery of early weight bearing in young, light-weight animals (Markel, 1994). These devices are intended to stabilize a fracture by acting as an internal splint, forming a composite structure in which both the bone and the rod contribute to fracture stability. This load sharing property of rods is fundamental to their design and should be recognized when they are used for fracture treatment.

In general, the overall rigidity of intramedullary rods increases with rod diameter because the moment of inertia is approximately proportional to the fourth power of the rod radius. The unsupported length of intramedullary fixation describes the distance between implant bone contact at the proximal and distal segments of bone. This distance shortens as the fracture heals. In the initial stages of fracture healing, the unsupported length of a rod is important. For the unsupported length in bending, interfragmentary motion is proportional to the square of the unsupported length. Therefore, a small increase in unsupported length can lead to a larger increase in interfragmentary motion. The most commonly used intramedullary pins are Steinmann pins, which range in size up to 6.3mm (0.25 inches). Intramedullary pins are available with either trocar, chisel or trocar-threaded tips. Threaded pins are recommended for the repair of neonatal bone, which is less dense and therefore more prone to allowing migration (St-Jean *et al.*, 1992). Intramedullary pins can be applied by a hand driven or power assisted device. Intramedullary pins should be secured in the subchondral epiphysis, and care should be taken not to introduce or maintain intramedullary pin through the articular surface because of ensuing degenerative joint disease.

Conclusion

By this present study, it can be concluded that the intramedullary pinning stimulates the early beginning of bone repair process in bull when compared to another internal skeletal fixation. Finally, application of intramedullary pinning was safe, economical and correct treatment procedure for humerus fracture management.

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Figures

Figure (1.1): Initial observation (Lameness)

Figure (1.2): Radiological examination (Before surgery)

Figure (1.3): Preparing for surgery

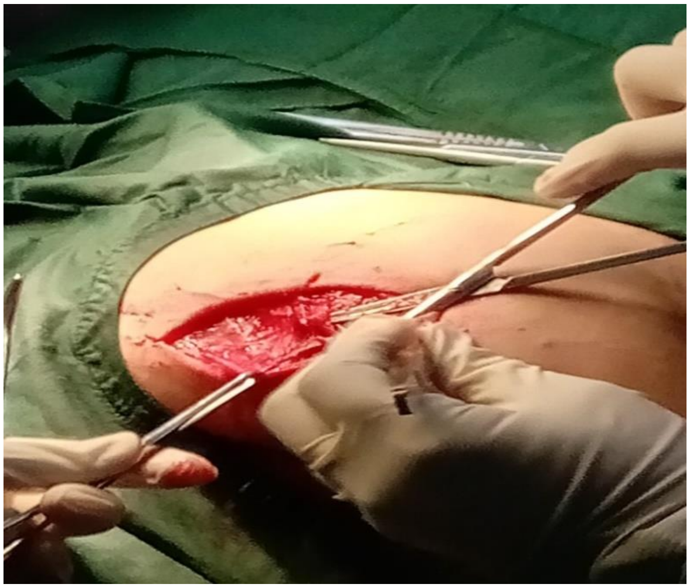

Figure (1.4): Make incision and muscle separation

Figure (1.5): Exposing of the bone

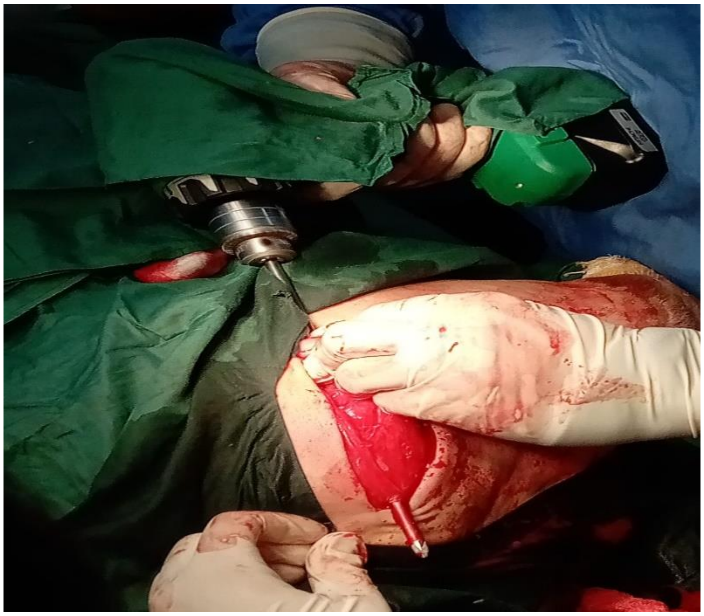

Figure (1.6): Drilling intramedullary pin

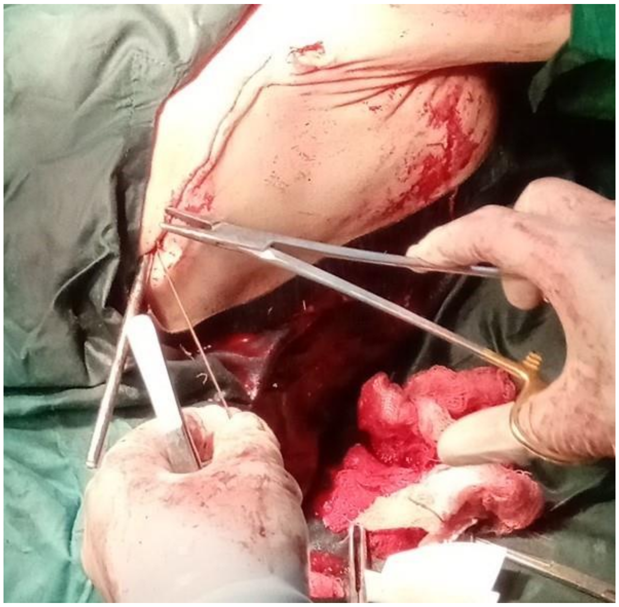

Figure (1.7): Suturing

Figure (1.8): Cutting the extra part of intramedullary pin

Figure (1.9): Bandaging

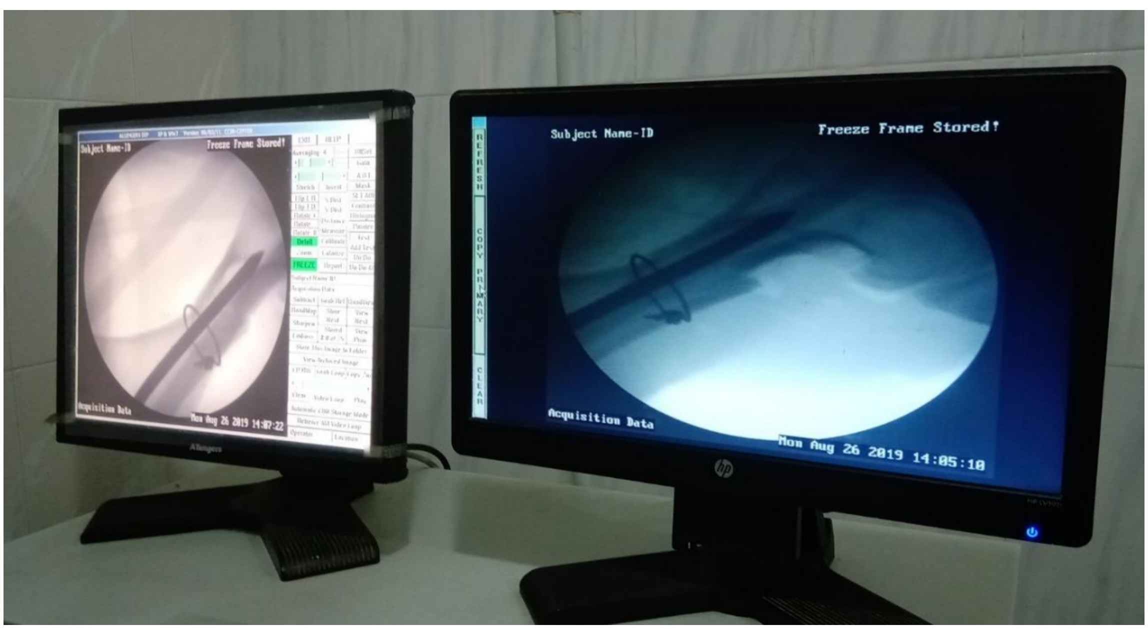

Figure (2.0): Radiograph (After surgery)

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The Author,

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