

## Scientific Report

# Conservative management with external coaptation technique for treatment of a severely comminuted fracture of the proximal phalanx in a Holstein-Friesian cow

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## Summary

A 3-year-old Holstein-Friesian cow was evaluated because of sudden onset of right hind limb lameness and pain with fetlock swelling for 2 days. Based on the history, clinical index scores and computed radiographic examinations, the case was accurately diagnosed to be a severely comminuted fracture of the proximal phalanx. This cow was assigned for conservative treatment with external coaptation technique. Over the repair follow-up period, the treated cow showed considerably improved clinical index scores and returned to its previous production level. In conclusion, conservative management of comminuted fractures of the proximal phalanx can provide a proper stabilization of the fracture and enable an affected cow to be returned to its intended production with minimal cost.

**Key words:** Comminuted fracture, Proximal phalanx, Cow, Conservative, Computed radiography

## Introduction

Information from livestock insurance companies suggests that about 10% of total cattle losses are due to limb fractures (Adams and Fessler, 1996; Desrochers *et al.*, 2014). Limb fractures in cattle are often the result of either a direct traumatic injury or entrapment injuries (Aithal and Singh, 1999; Watkins, 2006). The most common fractures in cattle include those of metacarpus and metatarsus (50%), tibia (12%), radius and ulna (7%), humerus, femur and pelvis (<5% each), while fractures of the phalanges are markedly rare (<1%) (Aithal and Singh, 1999; Gangl *et al.*, 2003; Marchionatti *et al.*, 2014).

Comminuted fractures of the proximal phalanx are rare injuries in cows (Aithal and Singh, 1999) and are classified into moderate or severe comminuted fracture (Kraus *et al.*, 2004). Reported methods of comminuted fracture treatment include stall rest, external coaptation, transfixation pinning and internal fixation techniques (Martens *et al.*, 1998; Ewoldt *et al.*, 2003; Nuss, 2014; Vogel and Anderson, 2014). External coaptation techniques include the use of a half-limb fiberglass cast which became the treatment of choice for fractures of the digit in cattle (Wilson and Vanderby, 1995; Adams and Fessler, 1996; Mulon and Desrochers, 2014).

The decision to treat a fracture in a food animal is made by considering the cost and success rate of the treatment, the perceived or potential economic or genetic

value of the animal, animal weight, the location and type of fracture and experience of the veterinarian (Nixon, 1996; Kraus *et al.*, 2004; Anderson and Jean, 2008; Jean and Anderson, 2014).

The present study is designed to report the outcomes of conservative treatment of a severely comminuted fracture of the proximal phalanx in a Holstein-Friesian cow. Also, it attempts to develop a consistent approach of the clinical index score and computed radiography for diagnosis, prognosis and repair follow-up of this type of fracture.

## Materials and Methods

### Case history

A 3-year-old Holstein-Friesian cow, weighing 435 kg, was evaluated at the farm of Obihiro University of Agriculture and Veterinary Medicine due to a 2-day history of sudden onset of severe right hindlimb lameness (grade 4/5). Signs of swelling and mild diffuse pain were elicited in response to palpation of the distal metatarsal region, with a focal area of intense pain response on the fetlock and pastern regions.

### Clinical index scores

The cow was clinically evaluated at walk and rest for subjective assessment of clinical signs, visual and palpable abnormalities of the proximal phalanx and circumferential measurements of the right hindlimb at

**Table 1:** The clinical index scores for subjective assessment of clinical parameters in a Holstein-Friesian cow with a severely comminuted fracture of the proximal phalanx

| Clinical index     | Description and level  |
|--------------------|--|
| Lameness           | 1 = No unevenness of gait or tenderness<br>2 = Uneven gait, perhaps tenderness of feet<br>3 = Slight lameness not affecting behavior<br>4 = Obvious lameness, some difficulty in turning, behavior affected<br>5 = Severe lameness, extreme difficulty in walking, adversely affected behavior |
| Discomfort         | 0 = Comfort, 1 = Discomfort  |
| Pain               | 0 = Negative, 1 = Mild, 2 = Moderate, 3 = Severe   |
| Limb circumference | 0 = 15 cm, 1 = 16 cm, 2 = 18 cm, 3 = 20 cm   |

the suspected fracture site. All of these parameters were recorded and scored as clinical index scores to be evaluated and compared along the follow-up duration of the comminuted fracture (Table 1).

The cow was examined for lameness pre- and post-conservative management. Lameness was graded on a scale from 1 to 5 according to Manson and Lever (1988). Pain was evaluated firstly by manipulation and fetlock joint flexion and was closely monitored during the follow-up period by reluctant or difficult ambulation, prolonged recumbency and elevated pulse rate, respiratory rate, or rectal temperature. Yet, discomfort was closely assessed by alteration in normal activities and appetite of the affected cow, as well as by alternation in state and change in normal attitude with prolonged recumbency. The limb circumference was examined using a measured tape in the middle of the proximal phalanx in normal cows as control and the affected one along the follow-up period (Table 1).

### CR examination

Radiographic evaluation of the right hindlimb proximal phalanx was conducted using a 70 kVp, 2 mAs radiography unit (HITACHI Sirius 125 A, Hitachi Ltd., Tokyo, Japan) with a 70 cm focal film distance. Standards radiographs were obtained for the affected limb using CR: dorsoplantar, lateromedial, and dorsolateral-plantomedial oblique views. The contralateral limb was also imaged as a control. The radiographs were visualized using a CR system (FCR CAPSULA-2V, Fuji Film Corporation, Tokyo, Japan). All radiographs were interpreted by a radiologist in comparison to the contralateral limb radiographs at the different times of evaluation until complete healing.

Assessment of the images revealed multiple radiolucent lines which extended obliquely across the distal halfway between the fetlock and pastern joints involving the shaft of the first phalanx. The radiolucent lines of the comminuted fractures appeared to extend from the medial and lateral margins of the proximal phalanx. The radiographic interpretation showed a comminuted fracture of the proximal phalanx.

### Treatment

The fractured cow was initially treated with conservative management. A nonsteroidal anti-inflammatory drug (Flunixin meglumine: 1.1 mg/kg twice daily intravenous) was administered. Penicillin

(200,000 IU/ml) and streptomycin (250 mg/ml) were given IM for one week. Over the following 24-hour, improvement was marginal with persistence of grade 4/5 lameness. The cow was secured in lateral recumbency, with the fractured limb downward. Xylazine was administered intramuscularly at 0.2 mg/kg to facilitate casting of the cow with good muscle relaxation. A cotton rope was tied around the hoof of the affected limb to apply tension and to facilitate the reduction of bone fragments. An external coaptation with a simple half-limb fiberglass cast was placed around the digit of the right hindlimb circumferentially, from a point immediately distal to the hock extending to encase the foot. The cow was maintained in the fiberglass cast with strict stall rest and received a gradually tapering dosage of flunixin meglumine (1.1 mg/kg twice daily intravenous) over a period of 10 days after injury.

### Repair follow-up

Clinical and radiographic follow-up examinations were performed for the affected limb after conservative management for 6 months.

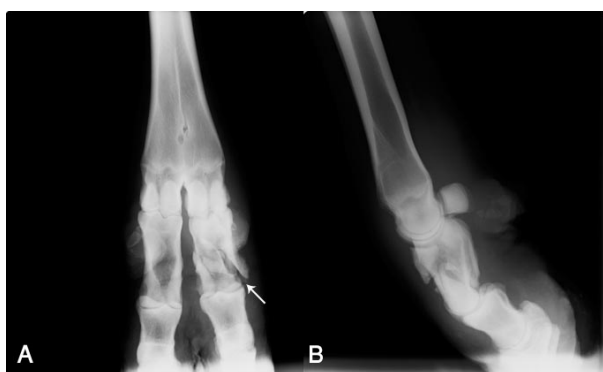
### Results

The severe comminuted fracture of the proximal phalanx in a Holstein-Friesian cow was repaired conservatively and successfully. The joint mobility and limb usage improved gradually and the cow returned to its previous production level along the repair follow-up period.

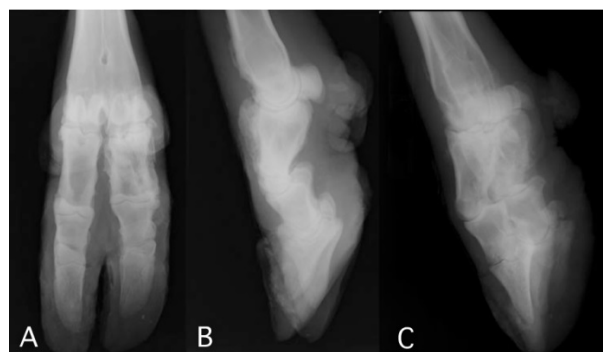
At the time of evaluation, the clinical index scores of the conservatively treated cow showed severe lameness (grade 4/5) with severe pain (score 3), discomfort (score 1) and increased limb circumference (score 2). This cow was kept in the half-limb fiber glass cast for 2 months, thereby inducing progressive improvement in the lameness without any cast complications. After 2 months, the cow showed lameness (grade 2/5) of the right hindlimb with mild pain (score 1) and decreased limb circumference (score 1) at the site of fracture. The contralateral limb showed a moderate degree of fetlock hyperextension which was gradually corrected to the normal attitude by repair progression at the 3rd month. Three months after injury, the cow was free from lameness and pain and regained its normal limb circumference (score 0). After 6 months, there was no detectable lameness and the cow regained its previous

level of production.

The follow-up radiographs taken soon after fixation of the fracture demonstrated more radiographically apparent fracture lines (well defined radiolucent area) with no displacement at the shaft of the proximal phalanx (Fig. 1). Subsequent radiographs did not show any change in the position of bone fragments. On the 15th day, radiographs showed little periosteal reaction around the fracture ends with good callus reaction between the bone fragments. On the 30th day, after closed reduction by external coaptation with half-limb cast, a complete bridging callus was noticed. Radiographs taken 2 months after cast removal showed signs of remodeling around the fracture site. Three months later, there was evidence of good remodeling at the fracture site. However, a slight periosteal reaction was still visible. At that time, there was a near-normal functional recovery of the limb in the affected cow. Four months after injury, repeated radiographic examination did not reveal the presence of fracture lines. Radiographs taken after 5 and 6 months demonstrate complete healing and remodeling of the fracture site (Fig. 2).



**Fig. 1:** Dorsoplantar (A) and lateromedial (B) radiographic views of a severely comminuted fracture of the proximal phalanx of the right hindlimb of a Holstein-Frisian cow. Notice that the radiolucent fracture lines extend the length of the proximal phalanx (arrow) with no displacement at the shaft of the proximal phalanx



**Fig. 2:** Dorsoplantar (A), lateromedial (B) and dorsolateral-plantomedial oblique (C) radiographic views of the cow in Fig. 1, six months after closed reduction and external fixation with a half-limb cast of a severely comminuted fracture of the proximal phalanx. Notice that there is a complete healing and remodeling of the fracture site as the fracture line is barely visible

## Discussion

Casts and splints are used separately or in combination in all types and sizes of ruminants as a successful, effective and economical method for fracture repair (Baird and Adams, 2014). The more distal the injury the more external fixation becomes the optimal method for success (Gangl *et al.*, 2003; Mulon and Desrochers, 2014; Vogel and Anderson, 2014). Newer fiberglass casting materials are more resistant to breaking and do not become weak when wet if sufficient cast material is used (Wilson and Vanderby, 1995). Also, their mechanical properties and durability are vastly superior and they achieve near maximum strength within minutes of application (Wilson and Vanderby, 1995). Conservative management appears to be a successful practical and non-invasive mean of managing cow with severely comminuted fractures of the proximal phalanx. The half-limb fiberglass cast provides substantial stability of the fracture which induces a marked fracture healing.

Comminuted fractures of the proximal phalanx in which internal fixation is not possible are still extremely challenging injuries (Kraus *et al.*, 2004; Nichols and Lardé, 2014). A good prognosis can be given in the cases of phalangeal fracture if they are not opened (Gangl *et al.*, 2006; Neera and Udrescu, 2015). In this case report, the fracture was severely comminuted but not opened, and was treated by external fixation. It had a favorable clinical and radiographic outcome with good fracture healing, and sound postoperative outcome.

Multiple and repeated high quality radiographs may be necessary to demonstrate the fracture and monitor its healing (Ramzan and Powell, 2010). Lateromedial dorsoplantar views confirm fractures in the frontal and sagittal planes. Additional oblique radiographic views can be also obtained if needed to assess fracture configuration. In the present case report, CR is used for the descriptive radiographic evaluation of a comminuted fracture of the proximal phalanx in the right hindlimb of a Holstein-Friesian cow. Computed radiographic evaluation provides a reliable tool for the case diagnosis, prognosis and monitoring of the conservative management outcomes. In general, proximal phalanx fractures that progress to healing show radiographic evidence of healing after 3 months and evidence of bone union 6 months after injury.

The clinical index scores provide a useful indicator of the body condition, vitality, lameness, pain and limb circumference of the fractured cow. The clinical improvement after successful conservative repair was represented by improved vitality and appetite, and reduction of lameness and pain of the treated cow. The clinical recovery was represented by normal weight-bearing without apparent lameness and pain in the treated cow.

Collaboration between the clinical index scores and computed radiography initiate a constant approach for a precise diagnosis, prognosis and monitoring the outcomes of a severely comminuted fracture of the

proximal phalanx.

In conclusion, conservative management of comminuted fractures of the proximal phalanx provides a proper stabilization of the fracture and enables the affected cow to be returned to its intended production with minimal costs.

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