

## Case Report

# Infrared Thermography as an Adjunct Tool for the Diagnosis of Fracture in a Racing Buffalo Bull: A Case Report

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### ABSTRACT

**Introduction:** Lameness is a severe clinical issue in racing animals, which can severely affect their health. Therefore, identifying the cause of the lameness is a crucial step in its diagnosis. Animals with subclinical etiologies are difficult to be identified in field conditions. Infrared thermal imaging is an advanced diagnostic tool for locating the injury site. Although sports injuries are regular in buffalo bulls used for traditional racing in villages, fracture diagnosis is challenging when regular clinical examination, lameness evaluation, and palpation of suspected areas fail to detect a sign. Hence, infrared red thermography can accurately localize the lameness region and locate the radiography area. Timely intervention with this technological tool can prevent further aggravation of the condition and relieve pain in the animal.

**Case report:** A 5-year-old buffalo bull was presented to the Teaching Veterinary Clinical Complex at Mannuthy, Thrissur, Kerala, India, on September 2021, with intermittent lameness exhibited in the right forelimb. However, the animal appeared healthy on detailed clinical, physiological, and hematological examinations. Using infrared thermal imaging, increased thermal activity was detected at the distal aspect of the right forearm region. The radiograph of the right forelimb revealed a hairline fracture in the distal part of the radius. The animal completely recovered after the treatment with non-steroidal anti-inflammatory drugs and rest for three months.

**Conclusion:** Infrared thermography is a simple and non-invasive method to identify the diseased location based on its thermal activity. In the present study, the correct location of the fracture site was discovered using infrared thermography.

## 1. Introduction

Thermography represents the pictorial form of the surface temperature of an object<sup>1</sup>. Infrared thermal imaging or Infrared red thermography (IRT), which is non-intrusive and non-contact, is a reliable indicator for detecting changes in the skin surface temperature<sup>2</sup>. The sympathetic part of the autonomous system can control the local skin surface microcirculation<sup>3</sup>.

In infrared thermal imaging, a specialized camera captures the emitted heat from the surface of an object. After capturing thermal radiations from the afflicted area, a color map of the thermal pattern called a thermogram is created<sup>4</sup>. Due to the non-invasive nature

of the operation, it is highly effective in the veterinary profession for non-cooperative and aggressive animals. The use of infrared thermography can determine the location of a lesion<sup>5</sup>. Infrared thermal imaging is equally useful in veterinary and medical fields for finding the local inflammation that occurs due to disease or injury<sup>6</sup>. It is also a valuable tool for determining the presence of infection, edema, and stress in animals because it allows for the visualization of temperature distribution and can detect changes in peripheral blood flow from the subsequent changes in heat loss<sup>7</sup>. Digital infrared thermography was also helpful for detecting lameness in

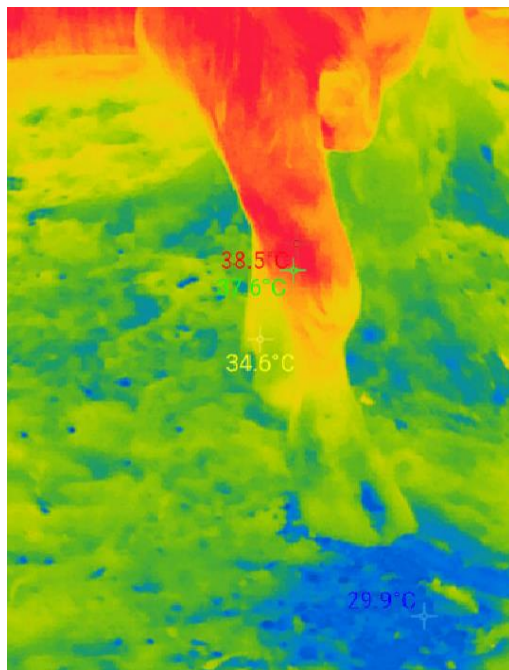
dairy cattle<sup>8</sup>. Early detection of the infectious condition of the animal is possible through this method<sup>9</sup>. In orthopedics, infrared thermal imaging helped to display the problems associated with bone fracture and tendon rupture<sup>5</sup>.

Lameness is a severe condition affecting the animal's normal regular activity and productivity. The lameness is defined as the clinical presentation of an animal with impaired locomotion, regardless of its etiology<sup>10</sup>. Lameness in bovines caused by laminitis, navicular disease, joint diseases, long bone injuries, tendon injuries, ligament injuries, and muscle injuries can be easily identified using IRT<sup>11</sup>.

## 2. Case report

A five-year-old Murrah racing buffalo bull weighing 500 kg was brought to the Teaching Veterinary Clinical Complex at Mannuthy, Thrissur, Kerala, India, in September 2021 with intermittent lameness in the right forelimb for the past 10 days. There was a history of racing in the previous week. All the physiological and hematological parameters were within normal limits. The gait and posture of the bull appeared to be normal. Palpation of the site did not elicit any signs of pain. Infrared thermal images were recorded in a smartphone (Product name: Samsung Galaxy S20FE 5G, Model name: SM-G781B/DS) using a mobile phone thermal imager (Model Name: HT-301, Manufacturer: Dongguan Xintai Instruments Co. Ltd, PRC) which was attached to the phone using phone's type-C interphase (Figure 1).

The thermal image of the right forelimb revealed enhanced thermal activity in the area of the right distal



**Figure 1.** The contralateral limb of the Murrah buffalo bull showed 34.6°C as skin temperature. The affected area was at 38.5°C and the nearby area was at 37.6°C as skin temperature



**Figure 2.** Hairline-fracture at distal radius of Murrah buffalo bull

forearm region, compared to the surrounding area and similar region of the contralateral limb (Figure 2). A hairline fracture in the right distal radius was observed on radiographic examination.

The animal was treated with intramuscular administration of the non-steroidal anti-inflammatory drug flunixin meglumine at the rate of 1.1 mg/kg body weight for 5 days, along with intramuscular administration of methyl cobalamine as supportive therapy. Flunixin meglumine is the FDA-approved non-steroidal anti-inflammatory drug for treating the pain associated with musculoskeletal injuries in cattle, horses, and pig<sup>12</sup>. Due to the absence of severe clinical signs, no external or internal immobilization methods were advised, and the animal's condition was managed with rest. Animal had an uneventful recovery in three months. Due to the owner's distant rural area, the animal's transportation by road was economically very difficult for the owner. So, the owner reported the progress of the animal through a mobile phone.

## 3. Discussion

A study stated that infrared thermography is a non-invasive method to detect thermal radiation from the surface of any object<sup>13</sup>. The skin temperature is usually 5°C lower than the core body temperature (37°C). As a result, changes in skin temperature indicate disturbances of local tissue perfusion<sup>14</sup>. Abnormal body temperature was an indication of the disease condition of the animal, and the IRT method is used to find out the changes in the body surface temperature without any delay<sup>15</sup>. In humans, infrared thermography was an effective diagnostic tool for detecting pain and inflammation associated with the implantation of prosthetic knee joints<sup>16</sup>. The hot regions in

thermographic pictures showed increased circulation and metabolic rate due to infection or injury to the site. With infarction or autonomic system imbalance, cold regions were associated with reduced perfusion<sup>4</sup>. Thermography is working based on Planck's law, which states that all objects hotter than absolute temperature (0°K) will emit infrared radiation<sup>17</sup>. According to a published study, the thermography method is useful for detecting fluctuations in the surface body temperature caused by bone neoplasms and is also utilized to identify patients with non-localizable sources of lameness<sup>18</sup>. The thermal imaging method also detects diseases in large animal limbs, such as white-line disease, sole ulcers, and digital dermatitis<sup>19</sup>. The advantages of IRT include the lack of costly instruments, performed without any anesthesia, rapid image formation, and decreased client expense<sup>(20)</sup>. The biggest disadvantage of infrared thermography is that it only penetrates a few centimeters below the body's surface and has limited use in medium and long-haired breeds of dogs and cats<sup>5</sup>.

This technology was very useful for zoo animals to remotely and non-invasively assess their health status. In Koalas, the infrared thermal imaging technique was useful in assessing body temperature<sup>21</sup>. The IRT is also used to determine the temperature of vital tissues during a surgical procedure<sup>22</sup> and in laboratory animals, as a diagnostic tool for early pain assessment<sup>23</sup>. Rather than using as a sole diagnostic method, IRT can be used as an adjunct to other diagnostic modalities<sup>24</sup>.

## 4. Conclusion

Infrared thermal imaging is a non-invasive method, and it acts as an adjunct tool to other diagnostic modalities to locate the lesions in subclinical inflammatory conditions; thus, it is helpful in an early and accurate diagnosis. The outcome of the concurrent use of such advanced technologies with existing modalities is highly useful, especially in lameness cases where early diagnosis and treatment are the keys to an early return to normalcy.

In the present case report, with the help of infrared thermography, the exact location of the injured part was identified. So, it can be concluded the IRT technique is very useful in field conditions and also inexpensive. Early identification and timely treatment of the disease conditions associated with locomotion will increase the productivity and performance of the herd.

## Declarations

### Competing interest

The authors declare that they have no competing interests.

### Authors' Contribution

All authors conceived and contributed in the study. Giggin T and Deny Jennes attended the case, diagnosed

the disorder, provided treatment, and wrote the first draft. Anoop S and K D John Martin contributed to the discussion. All authors read and critically revised the manuscript for intellectual contents and approved the final version of the manuscript for publishing in the present journal.

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### Availability of data and materials

The manuscript contains all datasets generated and/or analyzed in the current study.

### Ethical considerations

Ethical issues (including plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy) have been checked by all the authors.

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