EVALUATION OF BONE PROLIFERATION IN DOGS VIA COMPUTED TOMOGRAPHY

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Abstract

In this study, the results of computed tomography were evaluated in 8 patients including 3 female and 5 male dogs with bone growth as a result of clinical and radiographic examinations in Surgery departmen's clinic of Ankara University Veterinary Faculty, between the years of 2016-2017. Two dogs were under 1 year old and the others were between 1-4 years old. When the cases were examined by computed tomography after clinical examination and radiography, chondromatous proliferation, avasculer necros, greenstick fracture and malunion after treatment complication including 4 femur, periostal proliferation and synostosis including 2 radius ulna, fibrochondroosteosarcom including a scapula and ankylosis after old bone fracture including a cubiti bone proliferation were detected.

Keywords: *Bone, bone proliferation, computer tomography, dog.*

Introduction

The strength of the tissues of the living organism causes the lost of integrity in the region due to mechanical effects. As a result, lesions such as fractures and cracks can be formed locally in the bone. These lesions may develop as a result of hematogenous bone inflammation as well as sharp object wounds or trauma (Schwarz and Saunders 2011).

The bone responds to the lesions in three different ways: bone reproduction (osteogenesis), bone loss (osteolysis) or bone loss, and bone growth at the same time (Dennis et al. 2001). In bone reproduction, painful swelling in the region, edema, abscess and functional walking disorders are encountered (Öztürk 2015).

Bone thickening is formed by bone growth occurring beneath the periosteum. Bone thickening is encountered when trabecular bone, primary or metastatic neoplasms, osteomyelitis, physical injuries, bone fractures, callus and osteopetrosis occurs (Houlton et al. 2006).

For diagnosis of the skeletal system diseases and changes, radiographic evaluation is important (Öztürk 2015). Bones unlike soft tissues have a light colored (radiopaque / hypersensitive) appearance by keeping more X-rays (less light transmitting). Diagnostic radiographs gives information about density changes, size, shape and contour changes, bone line and periostal reactions (Bumin 2015).

Continuous periosteal bone growth is a slowly progressing disease process that allows a new bone to form regularly. This process is seen in benign and non-aggressive lesions. Radio opacity is uniform in radiography. In intermittent periosteal reactions, rapidly changing lesions begin to repair by disrupting the cortex and periosteum. Malignant neoplasia and aggressive disease are encountered in the process. Radio opacity is variable and has a short unconnected appearance (Dennis et al. 2001).

In contrast to radiography, multiple images taken in computed tomography, which is one of the advanced imaging diagnostic methods, prevents superposition. Computed tomography is more sensitive in tissue contrasts than radiography (Sanal 2013, Woertler 2003). Cross-sectional (transversal, sagittal, dorsal and frontal) images in different directions and thicknesses of the region without moving the patient prevent artifacts formed by overlapping structures (Ünal 2008). Computed tomography also shows similarities in X-rays as in radiography. Measurement of density in bone tissue in radiography, cortical and cancellous bone status, lesion structure, calcified areas and ossification can be evaluated more easily (Ayvaz & Aksoy 2006).

In this study, it was aimed to visualize the bone growth in dogs by routine computed tomography (CT) examination, which is one of the advanced imaging diagnostic methods after routine clinical examination and radiographic evaluation.

Materials and Methods

8 dogs were brought to the Department of Surgery, Faculty of Veterinary Medicine, at Ankara University in 2016-2017. Short-term anesthetics of the patients who were evaluated according to the anesthesia protocol were provided with Propofol 200 mg/20 ml ampoule. For this, 6-8 mg/kg intravenous administration without premedication was performed and the effect was observed within 20-60 seconds, while 20-30 minutes from the anesthesia.

One of the advanced diagnostic methods in the Radiology Unit of the Department of Surgery, Ankara University Faculty of Veterinary Medicine, In the appropriate anesthesia protocol, transverse images of the related regions of the patients under anesthesia were taken in 1-3 mm thickness.

Results

The clinical data and the localization and diagnosis of the lesion were presented in Table 1.

In the first case, it was found that the right caput femoris was subluxated from the fossa acetabuli and the right posterior extremity was shorter than the left hind limb. Radiographs of the pelvis were obtained in the lateral position in the V/D and coxafemoral joints. Periosteal growths were seen in fossa acetabuli and caput femoris. In the V/D position, computed tomography images of the coxafemoral joint revealed periosteal enlargement in the radiolucent appearance on radiography. Histopathological evaluations of the biopsy specimen from the region were diagnosed as chondromatous reproduction.

Clinical examination of the case 2 revealed an open wound in the left anterior extremity, pain and sensitivity in the region. A/P and M/L radiographs of the left anterior extremity revealed periosteal proliferation in the distal radius of the radius-ulna. In the computed tomography images, periosteal growths were observed as radiopaque areas. It has been reported that there are localized bacterial reproductions in the microbiology laboratory where there is no osteomyelitis in the sample taken from the open wound area by sterile swap.

In the third case, pain and sensitivity in the posterior extremities, atrophy of the right hind limb muscles and asymmetry in the hip were determined in the clinical examination. It was also observed that pain sensation was more prominent in the right coxafemoral joint. In the radiographs of the left posterior extremity in the V/D and M/L positions in the pelvis, an old supracondyler femur fracture and excessive callus and bone growth were encountered on the left side. In the left caput femoris, osteochemical and moth-like necrosis and avascular necrosis were diagnosed. In the computed tomography images taken as transversal sections in V/D position, fossa acetabuli and caput femoris were encountered in a widespread reproductive area as regionally radiopaque areas.

In the clinical examination of the 4th case, with the hypersensitivity to the left art. cubiti, joint pain, mild edema in soft tissues, joint movements was determined and ankylosis was formed by limitation in extension and flexion. The left cubit was radiographed at M/L and A/P positions. Short periosteal growths were encountered in radiopaque areas in the procs. Anconeus of Ulna and condylus humeri. Proliferations of the proc. anconeus was observed to be caused by the formation from old fractures. In computed tomography images taken as transverse sections in the D/V position, the results of condylus humeri and ulna were determined. The periosteal growth observed in the anconeus was observed as radiopaque areas.

In the fifth case, a painful swelling was observed in the palpation with hypersensitivity to the right femur. Age fractures of the femur were determined in the radiographs of the pelvis in V/D and M/L positions of the right femur. Callus formations were observed in regionally distributed radiopaque areas. Transversal computed tomography images taken in V/D position showed periosteal growth and callus radiopaque areas.

In the sixth case, a severe painful swelling in the left radius-ulna was palpated on clinical examination. Radiographs of A/P and M/L of the radius-ulna revealed an old fracture and excessive callus formation. Computed tomography images of the region revealed synostosis which was not confirmed on radiography.

In the 7th case, a very large, hot and painful swelling was observed in the right scapula with hypersensitivity in the right scapula. Muscle atrophy was observed in the region. Right front extremity and thorax radiographs were taken in L/L position. A malignant bone tumor was considered due to the presence of aggressive lytic lesions in the right extremity and the presence of scattered reproductive sites in the region together with the sun burst appearance. Thorax radiograph showed metastatic areas in the lung. On computed tomography, these scattered proliferation areas were visualized as radiopaque areas. Histopathological examination of the biopsy revealed a diagnosis of fibrocondroosteosarcoma.

In the 8th case, at the clinical examination, it was determined that the extremity could not be used after osteosynthesis in the left femur and iatrogenic sciatic nerve damage was seen in the neurological examination. On the radiographs taken at V/D and M/L positions, it was observed that there was a pin on the fracture line, but malunion was formed as well as callus and periosteal reproduction. Computed tomography images taken after exyroation of Pin showed no fracture healing and a excessive callus formation.

Discussion and Conclusion

Radiography is an imaging method that supports clinical examination in routine musculoskeletal diseases (Samsar and Akın, 2003). Radiographic images provide information on the number, type, localization and structure of the lesion (Houlton et al. 2006). Cross-sectional imaging of computed tomography provides easy diagnosis for musculoskeletal disorders (Lande et al. 2013). Radiographs were taken routinely after clinical examination in study cases.

Computed tomography, which is one of the advanced imaging methods, is important for the diagnosis of diseases. Due to the time and the number of sections in terms of bone tissue integrity can provide more detailed and precise information (Samsar and Akın 2003). The definitive diagnosis of case number 6 was performed by computed tomography.

Changes in opacity in radiography provide information on bone growth. Computed tomography is more effective than conventional radiography in the diagnosis of fractures due to the use of versatile X-ray (Whatmough and Lamb 2006). Computerized tomography showed that the cortical bone had a larger and higher density structure, and the appearance of the cancellous bone as trabecular showed differences in bone composition and provided ease of diagnosis in the lesions

(Cheon at al. 2018). In the imaging, the intramedullary canal and endosteal changes of the bone are clearly observed. These changes are followed up by the patient in bone healing or lesion formation (Ketaki at al. 2012). It provides a more detailed visualization of bone healing by taking a cross-sectional image in this process by computed tomography (Ünal 2008). In particular, it facilitates the monitoring of bone healing in orthopedic operations such as osteosynthesis and postoperative period (Houlton et al. 2006). In the study, it was observed that in case no 8, the evaluation of the fracture complication, as well as the radiography, computed tomography showed a mora clear image at short intervals in the bone. In bone lesions, especially in morphological changes, radiography is preferred in terms of low cost and high usability; deformations in late stage can be easily followed by computed tomography.

In bone lesions, especially in morphological changes, radiography is preferred in terms of low cost and high usability; deformations in late stage can be easily followed by computed tomography. Common avascular necrosis can be asymptomatic until advanced stages. The deterioration of regional blood circulation and high intraosseous pressure accelerates this process. The radiological stages, prognosis and treatment of the disease can be routinely followed by computed tomography (Manenti at al. 2015). In the study, case 3 was diagnosed with avascular necrosis as a result of routine controls and computed tomography.

In this study, the importance and contribution of computerized tomography, which is one of the advanced diagnostic methods, to routine use in veterinary clinical practice was determined. In the evaluation, it was observed that the radiographs obtained after the clinical examination clarified the diagnosis subject, but it was observed that the computed tomography images were cross-sectional and at regular intervals were important for differential diagnosis in complicated cases.

As a result, it is concluded that it is appropriate to evaluate if there is an opportunity to benefit from computed tomography which is one of the advanced imaging methods in bone growth which can not be determined with definite diagnosis by radiography.

References

1. **Ayvaz M, Aksoy MC**. *Approach to Bone Tumor and Tumor-like Lesions, Hacettepe Medical Journal, 2006; 37: 124-131.*
2. **Bumin A**. *Diagnosis of Orthopedic Lesions in Dogs by Radiographic, Tomographic and Magnetic Resonance, 3rd Veterinary Orthopedics Congress, Congress Booklet, 2015; 94-121.*
3. **Cheon B, Park S, Lee S, Park J, Cho K, Choi J.** *Variation of Canine Vertebral Bone Architecture in Computed Tomography, J vet sci, 2018; 19(1): 145-150. https://doi.org/10.4142/jvs2018.19.1.145*
4. **Dennis R, Kirberger RM, Wrigley RH, Barr FJ.** *Skelatal System: General, Chapter 1, Small Animal Radiological Differantial Diagnosis, WB Saunders, 2001.*
5. **Houlton J, Cook JL, Innes JF, Langley-Hobbs SJ, Brown G.** *Radiography, BSAVA Manual of Canine and Feline Musculoskeletal Disorders, 2006; Chapter 2.*
6. **Karnik KS, Samii VF, Wisbrode SE, London CA, Green EM.** *Accuracy of Computed Tomography in Determining Lesion Size in Canine Appendicuar Osteosarcoma, Veterinary Radiology and Ultrasound, 2012; 53(3): 1-6. doi:10.1111/j.1740-8261.2012.01930.x.*
7. **Lande R, Reese SL, Cuddy LC, Berry CR, Pozzi A.** *Prevalance of Computed Tomographic Subchondral Bone Lesions in the Scapulohumeral Joint of 32 Immature Dogs With Thoracic Limb Lamennes, American Collage of Veterinary Radiology, 2013.*

8. **Manetti G, Altobelli S, Pugliese L, Tarantino U.** *The Role of Imaging in Diagnosis and Manadement of Femoral Head Avascular Necrosis, Clinical Cases in Miner Bone Metabolizm, 2015; 12 (suppl 1): 31-38.*
9. **Öztürk R**. *Bone and Soft Tissue Tumors, Ankara Oncology Training and Research Hospital, Department of Orthopedics and Traumatology, 2015.*
10. **Sanal HT**. *Radiological Imaging Methods in the Evaluation of Musculoskeletal System, Turkish Journal of Orthopedics and Traumatology, 2013; 12 (1): 1-6.*
11. **Samsar E, Akın F**. *General Surgery, Diseases of Bone Tissue, Medipres, 2003; Section 20.*
12. **Schwarz T, Saunders J**. *Artifacts CT, Veterinary Computed Tomography, Wiley-Blackwell, 2011; Chapter 4.*
13. **Ünal D**. *Imaging Techniques Used in Medicine, Gazi University, Gazi Faculty of Education, Department of Secondary Education Science and Mathematics Education, Department of Physics Education, 2008.*
14. **Woertler K**. *Benign Bone Tumors and Tumor-Like Lesions; 13: 1820-1835.*

Tables and Figures

Table 1. Clinical data from cases.

Case no.	Dogs			Lesion Localization	Diagnosis
	Breed	Age	Sex		
1	Mix	2	♂	Right femur	Chondromatoz reaction
2	Mix	3	♂	Left radius-ulna	Periostal reaction
3	Mix	8	♂	Left femur	Avascular nekrosis
4	Mix	2	♂	Left art. cubiti	Ankylosis/Old fracture
5	Mix	8	♀	Left femur	Semi furacture
6	Mix	2	♂	Right radius-ulna	Synostosis/Excessive callus
7	German shepherd	1	♀	Left scapula	Fibrokonroosteosarkom
8	Mix	3	♀	Sol femur	Fracture complication/ Excessive kallus

♂: Male, ♀: Female

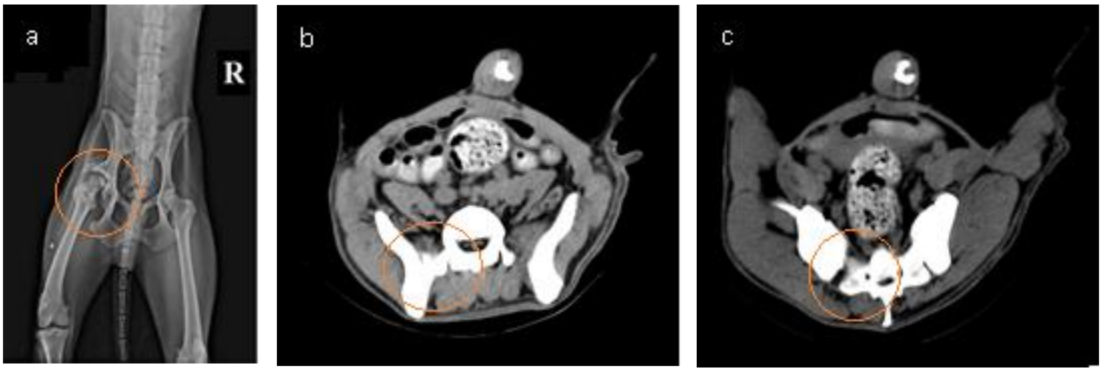

Figure 1. Radiography and computed tomography images of case no.1
(a. Radiography, b. and c. Computed tomography images)

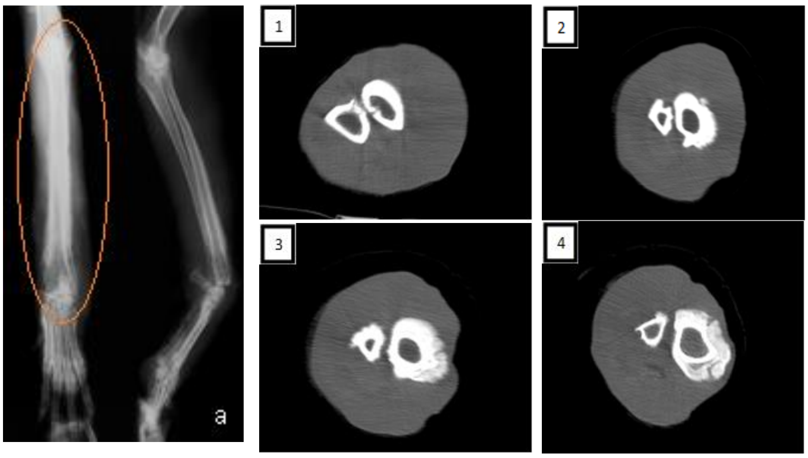

Figure 2. Radiography and computed tomography images of case no.2
(a. Radiography, 1.2.3. and 4. Computed tomography images)

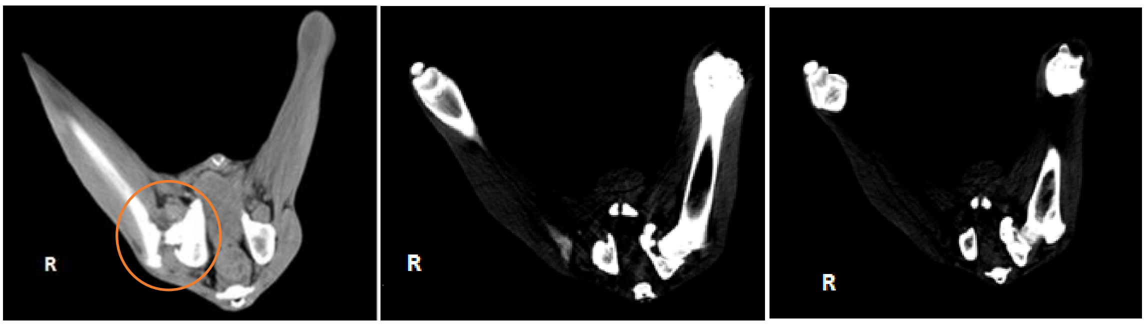

Figure 3. Radiography and computed tomography images of case no.3
(a. Radiography, b. and c. Computed tomography images)

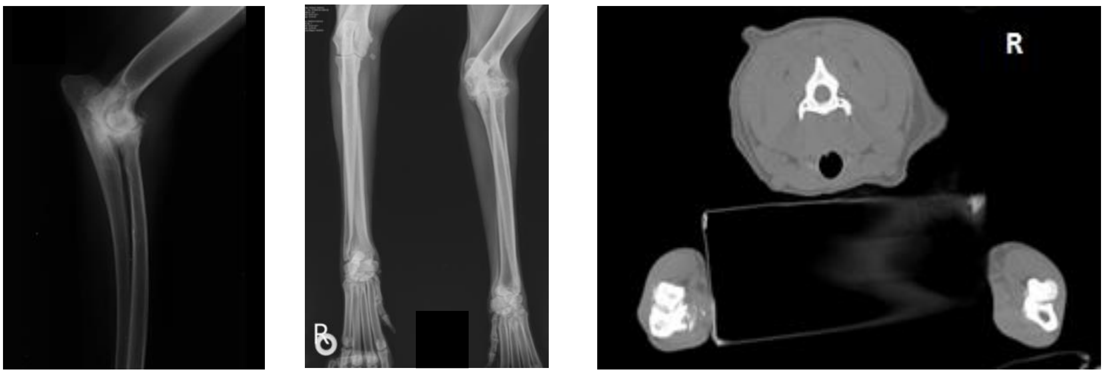

Figure 4. Radiography and computed tomography images of case no.4
(a. and b. Radiography, c. Computed tomography images)

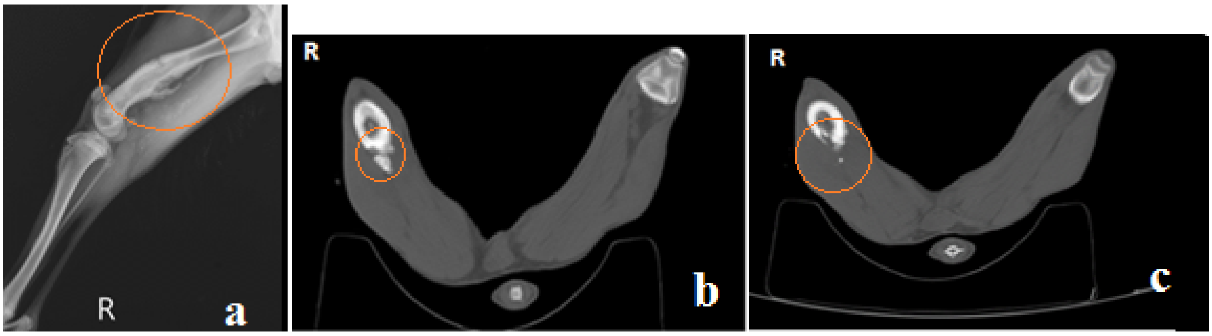

Figure 5. Radiography and computed tomography images of case no.5
(a. Radiography, b. and c. Computed tomography images)

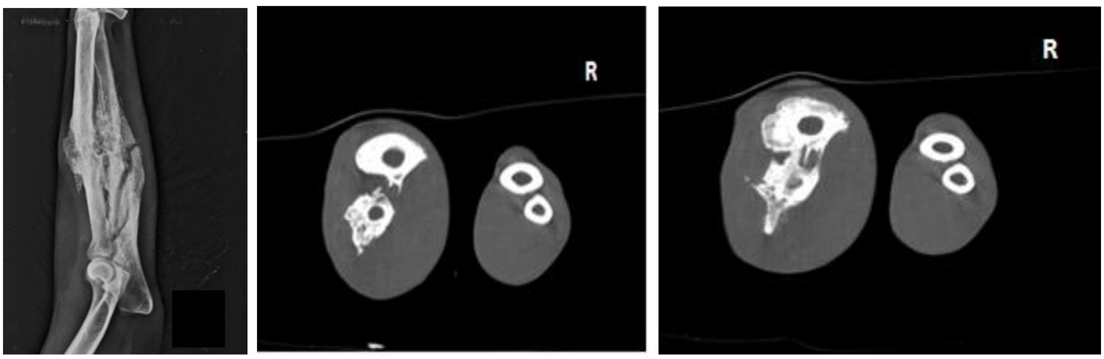

Figure 6. Radiography and computed tomography images of case no.6
(a. Radiography, b. and c. Computed tomography images)

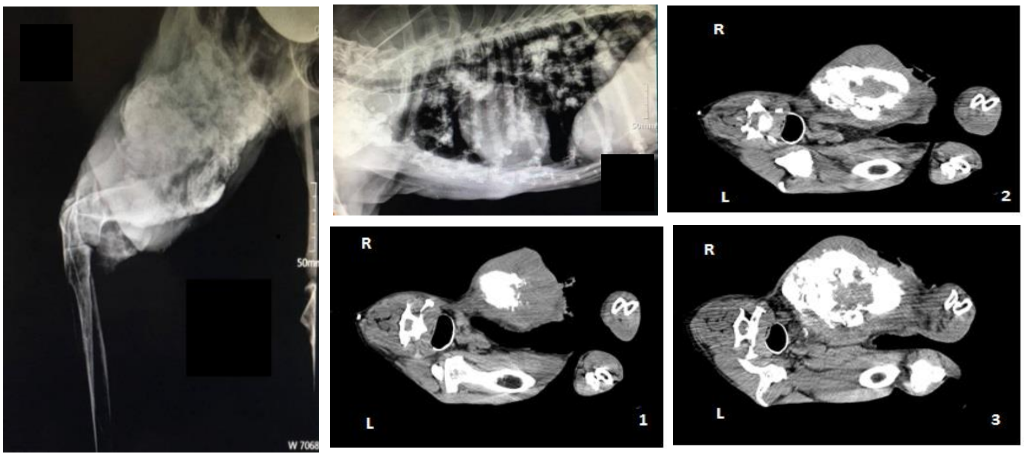

Figure 7. Radiography and computed tomography images of case no.7
(a. and b. Radiography, 1.2. and 3. Computed tomography images)

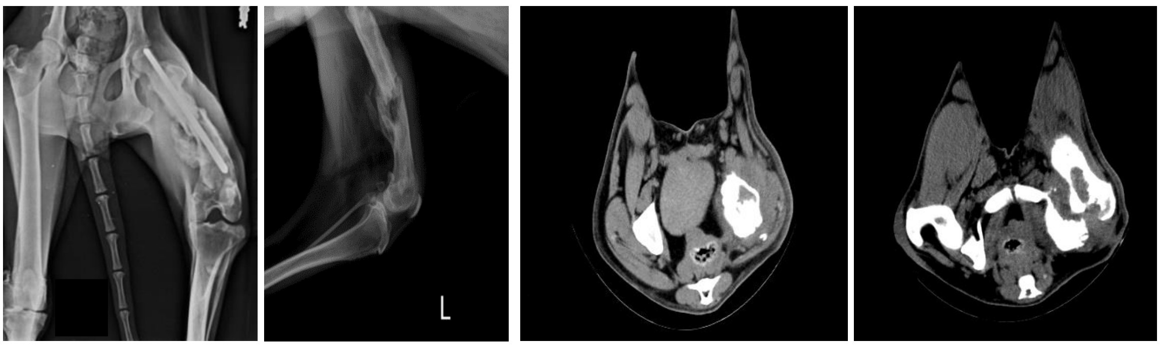

Figure 8. Radiography and computed tomography images of case no.8
(a. and b. Radiography, c. and d. Computed tomography images)

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