RSNA Radiological Society of North America
RADIOLOGICAL SOCIETY OF NORTH AMERICA
820 JORIE BLVD, OAK BROOK, IL 60523
TEL 1-630-571-2670 FAX 1-630-571-7837
RSNA.ORG
NEWS

Quantitative Dual-Energy CT Reveals Fluorine as a Noninvasive Biomarker for Osteomyelitis in a Tyrannosaurus Rex

PURPOSE

To exploit dual-energy CT (DECT) imaging for the investigation of the diseased left dentary of a Tyrannosaurus rex (T. rex) using a clinical CT-scanner.

METHODS AND MATERIALS

This study investigated the left dentary of the T. rex MB.R. 91216 which is 79.5 cm long and has a max. thickness of 81 mm. CT imaging was performed on a medical 320-row CT scanner with an X-ray absorption measurement range from -32768 to +32767 HU. A dual-energy helical scan mode with 80 and 135 kVp was used that switches between the two energies once during each rotation. Two custom and validated DECT algorithms were applied for the detection of calcium and fluorine, based on a three-material decomposition approach. For quantitative analysis identical regions of interest were placed in different parts of the investigated bone in the calcium and fluorine DECT dataset, respectively, and ANOVA with the Bonferrroni´s multiple comparisons test was applied.

RESULTS

The left dentary shows two notable findings on visual inspection and CT imaging, a diffuse thickening of nearly the entire left dentary with a homogenous distribution of calcium and a focal exophytic mass on the ventral surface of the dentary with a significant accumulation of fluorine ($p<0.0001$). Furthermore, the focal exophytic mass showed diminutive diffuse lucencies extending from the surface to the tooth root of the 5th replacement tooth and demonstrated a tapering shape with a fistular-like center, which also demonstrated a significant fluorine accumulation respectively ($p<0.0001$). The perseverance of anatomical structures within the mass suggests the diagnosis of tumefactive osteomyelitis.

CONCLUSIONS

While DECT imaging is a common clinical diagnostic tool, this study presents a novel DECT-based approach for the characterization of tumefactive osteomyelitis in a T. rex. Specifically, the noninvasive density- and element-based material decomposition of fossilized bone revealed that fluorine could serve as an imaging biomarker for areas with decreased bone density, helping paleontologists to investigate fossils without the need to harm their integrity.

CLINICAL RELEVANCE/APPLICATION:

DECT-based quantification of fluorine revealed a novel noninvasive imaging biomarker for osteomyelitis in vertebrate paleontology, underlining the role of radiology in paleontological research.