Actinomycosis versus Tuberculosis in Ancient Human Bone – a pilot study

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Introduction
Actinomycosis is a rare chronic infectious disease hallmarked by extensive tissue destruction. It is caused by several known subspecies of Actinomyces, these are anaerobic fastidious that regularly colonise the oropharyngeal, cutaneous, and gastrointestinal tract. In most cases, they remain asymptomatic. The disease can become symptomatic in previously healthy, broadened and abnormally oxygenated orifices other than the adjacent soft tissues or cavities by specific pathogens. 

Case presentations
A historically well documented case of Actinomycosis that concerns the vertebrae, sacrum, and pelvis of a 21-year-old female dated to the 16th century is examined (Fig. 2). The case was published by the authors of this paper (Schmally et al. 2015), and bone samples from areas presenting reactive bone formation were drilled out from below the vertebrae, sacrum, and pelvis of a 21-year-old female dated to the 16th century (Hansen et al. 2012). After isolation, each sample is inserted into a DNA library (Bayer & Schmally 2015) and sequenced on a Next Generation Sequencing platform (in preparation, first sequencing the fast algorithm MALT-HTC [Hofherr et al. 2016], with this assigning DNA reads to their respective source species (therefore identifying enterobacterial species associated with post-mortem bacterial infections, but most importantly endogenous microorganisms as well as pathogenic bacteria that might be associated to the presented pathological conditions). 

Fig. 1: Radiograph of the left hip bone showing a pathological change at the left iliac spine, indicating a disease process of the iliac bone. Note the thickening of the left iliac spine and the large amount of new bone formation at the iliac spine.

Methods
Following oral photographic and conventional radiological documentation, structural analyses and 3D-reconstructions by an X-ray based µCT scanner (Vigorix 8-848-4) were performed on the spine and, additionally, in the recent case, of the pelvis (transmission target: 110 kV, 110 µA; slice thickness: 0.3 mm) using an in-house µCT laboratory at the University of Vienna. These remnants are compared with the contemporarily interpreted pathological alterations observed at the ilium spine of a mature male skeleton recently excavated at the Ancient Maya City of Tikal (Low Society) that concerns a Heber-Actinomycosis. 

Results of the recent case
Macroscopically, the anterior surface of the lumbar spine shows the classic features of chronic bone formation at the vertebral endplates that is persistent by numerous fibrous seams (Fig. 1, 2, and 4). Radiologically in lateral view, it can be shown that these fibrous-osseous seams channel. The unaltered cortical bone appears to be thinned, but intact. Within the vertebral body especially in the D1 (third thoracic) vertebra, the trabecular exhibit signs of thickening and calcific alterations around some "hollow" areas (Fig. 2). The left hip shows pronounced thickening at the iliac crest due to newly built bone, and a disease trabecular network with a pseudo-osteoarthrotic related to the iliac crest (Fig. 6a, b, c).

Fig. 2: Macroscopical evaluation of the left iliac bone of a mature male skeleton. Highlighted are the cortical bone alterations at the iliac spine and in the pelvic bone, as well as the sclerosis of the iliac crest and iliac bone.

Discussion
Actinomycosis belongs to the oral, pulmonary, and abdominal groups, but following any mucosal or epithelial damage, this barrier might be passed and a chronic pulmonary lesion develops. Considering the disease as opportunistic in nature, it is typically the bone pathogen that concerns the osseous system (Zink et al. 2014). Nevertheless, the vertebrae of the lower back and the sacrum of the abdominal area are presented in here. As tuberculosis concerns the vertebrae, sacrum, and pelvis of the 21-year-old female dated to the 16th century (Hansen et al. 2012), and there are plenty of additional pathological alterations resembling tuberculosis. 

Fig. 10: Radiograph of the 4th and 5th lumbar vertebrae in lateral projection. Highlighted are the cortical bone alterations at the left iliac spine and the iliac bone.

Results of the mediaval case
Macroscopically, huge cavitations on one hand, and a fan-like pattern on the other hand, combined with bone voids and even bone loss on the right iliac spine were observed. Additionally, fibrous seams often occur in the vertebral bodies. Furthermore, numerous fibrous seams may concern the iliac bone. 

Fig. 11: Radiograph of the right iliac bone of a mature male skeleton. Highlighted is the cortical bone alterations at the iliac bone.

Literature


Fig. 12: Radiograph of the right iliac bone of a mature male skeleton. Highlighted is the cortical bone alterations at the iliac bone.

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Fig. 13: Radiograph of the 4th and 5th lumbar vertebrae in lateral projection. Highlighted are the cortical bone alterations at the left iliac spine and the iliac bone.

Fig. 14: Radiograph of the 4th and 5th lumbar vertebrae in lateral projection. Highlighted are the cortical bone alterations at the left iliac spine and the iliac bone.

Fig. 15: Radiograph of the right iliac bone of a mature male skeleton. Highlighted is the cortical bone alterations at the iliac bone.