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Research paper

A probable case of Actinomycosis (Lumpy jaw disease) with pseudo joint formation in dwarf cattle from the late medieval in Wysburg, Germany

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Abstract

Actinomycetes are Gram-positive anaerobic bacteria that cause disease in cattle and sometimes other animals. Mandibular abscess is a localized, chronic, progressive granulomatous abscess that often involves the mandible, maxilla, or other bones of the head. When an infection occurs, byproducts of the infection begin to break down bones. This article aims to determine the possibility of disease in the medieval bones of these animals, to identify and analyze their macro-structural features and their diagnostic potential value in the archaeological skeletal material of studied animals. This late medieval (13th-14th century) document was found in Wysburg, near Weisbach in the Saale-Holzland-County in the central German state of Thuringia. Macroscopic and histopathological examination of the bone revealed a lesion in the lower jaw, suggesting that it may result from actinomycosis (Mostly in the jaw). Descriptions of jaw bones are rare in the paleo-pathological literature. Analysis is limited by the absence of other anatomical elements of the affected animals, which affects the interpretation of the paleo-pathological skeleton. For further research, it is recommended that similar studies be conducted on better-preserved animals.

Keywords: *Actinomycosis; Archeozoology; Cattle; Late Medieval Age; Wysburg; Germany.*

1. Introduction

Cattle were the most economically important livestock in the medieval Ages (Janeczek et al., 2024). Numerous archaeo-zoological studies of bone from the beginning of Piast's country (10th- 13th century), indicate that they were kept for meat and dairy products (Makowiecki, 2006; 2009, 2018; Iwaszczuk, 2014). Elements of cattle skeletons were basic raw materials for making different items for everyday life (Jaworski, 1990), while hides were used for making leather products (Radek, 1979; Kowalska and Radek, 2015). Mandibular and dental diseases accounted for nearly 15% of all the pathologies affecting cattle raised in early medieval (Makowiecki et al., 2021; 2023). Originally classified as a disease, actinomycosis is now considered a chronic bacterial disease. Although jaw involvement often presents with normal features, postcranial disease does not. Actinomycosis is a polymicrobial infection characterized by widespread tissue destruction. The destruction of tissue and inflammatory bone depends on the disease involved. Bones are rarely affected and are often discussed in the context of different diagnoses and their macromorphological similarities with other pathologies (Baker and Brothwell, 1980; Bartosiewicz et al., 2013; Ahab et al., 2020; Janeczek et al. 2024).

Actinomycosis, commonly known as "Lumpy jaw" is caused by Actinomycetes bovis, which is endemic to the bovine mouth. Actinomycosis is a bacterial infection that is more common in cattle than in goats and sheep. Bacteria enter through cuts and scratches (for example, from broken teeth or roughage) and migrate into bones, causing osteomyelitis (inflammation and infection of the bony tissues) (Fig. 1).

The bacteria that causes jaw disease (Actinomyces bovis) enters the oral tissues through an open wound. These wounds may be caused by foreign objects (sticks, wires), plant awns, foxtail awns, or hard objects. These bacteria can be found in the mouth of healthy cows. When an infection occurs, byproducts of the infection begin to break down bones. In response to bone disease, the body attempts to repair itself by building new bone. This process creates a honeycomb-like structure and creates a small bone structure filled with acid. As the infection progresses, large cavities may appear and cause pus to drain. Due to the nature and location of the disease, cows may experience eating and drinking problems. The animal often begins to lose health, which over time can lead to death. Chin bumps are not generally considered to be very contagious, but the disease can spread from one animal to another through saliva and pus that contaminate food and water. This disease usually affects only one or two animals, but infection can also occur in cattle that eat hay or foods containing abrasives. The purpose of this article is to try to determine the cause of disease in animals.

Fig. 1: Clinical Picture of a Cow with Actinomycosis; Note the Typical Enlargement of the Mandible. (Courtesy of Dr. Geoffrey Smith).

2. Materials and methods

The bone under investigation was a cattle caudal fragment of the right mandible (Fig. 2). The specimen, exhibiting chronic disease was diagnosed in a late medieval cattle remains discovered during excavations in the Wysburg. Wysburg is a castle in Thuringia, Germany and situated nearby to Schloßkopf and Zschachenmühlberg. The bone underwent macroscopic and histopathological examination.

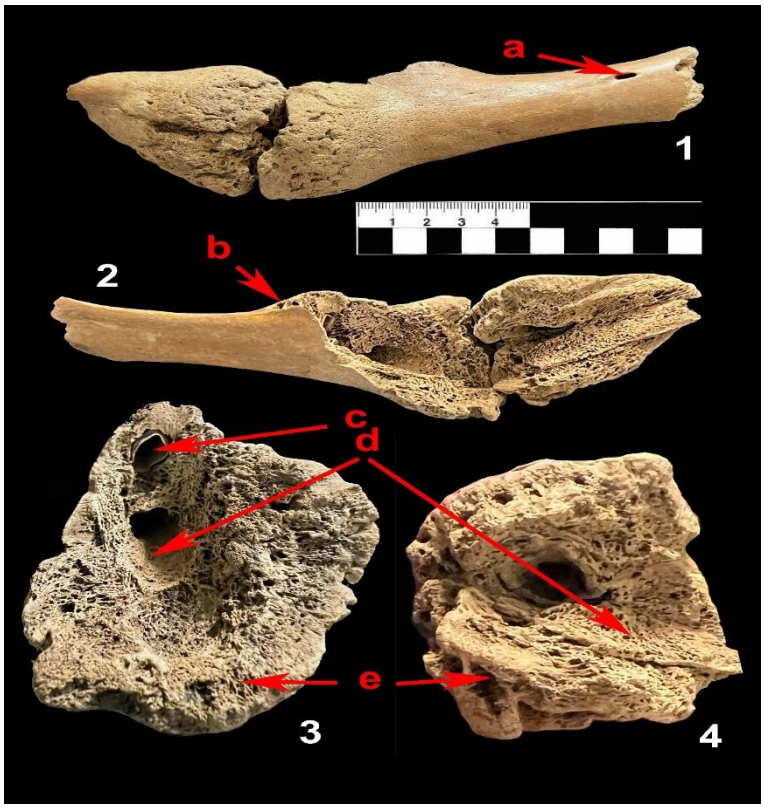

Fig. 2: 1 - Right Mandibular Branch From Labial, 2 - From Lingual, 3 - View of the Anterior Part, 4 - View of the Posterior Part, A- Mental Foramen, B- Impression of the Milk Tooth and Porosities of the Underlying P2 in the Thrust, C - Tooth Germ of P2, D - Parts of the Corpus Mandibulae, E - Ossified Masses of the Inflammatory Tumor; 1+2 - Scale Bar 10 Cm, 3+4 - Without Scale Bar.

3. Results

According to Karl (2020), the following insights can be gained from the archaeozoological analyses of the late medieval animal bone remains from Wysburg. When comparing the present results with those of Barthel (1996), there are only slight shifts, which essentially result from the breakdown, e.g. the separate indication of youth types. All other differences in bone numbers and their percentages are balanced. There is therefore no significant difference in composition when comparing the animal bone material of the outer bailey and the core bailey. In the bundle of Wysburg domestic cattle bones, about a fifth does not correspond to the "normally" built pieces for the Middle Ages, but can be related osteometrically to dwarf cattle. The FWK in domestic cattle moved relatively from A < B > C. The WRH could be at least 106.1 mm for metacarps (n = 4), MW 116.92 mm max. 126.2 mm and for metatarses (n = 7) min . 105.84 mm MW 110.51 mm max. 114.85 mm can be calculated. It cannot be determined whether this was a genetically stable, dwarfed local breed, or a deficient form.

An adaptation through breeding to the climatic and associated agricultural conditions in the Thuringian Schiefergebirge is conceivable but has not yet been proven. Statements about the regional distribution of these morphs are also not possible from the available material. Only a pathogenetic background can be excluded for the reduction of the hypoconid (Karl 2019). Asymmetrical abrasion due to tooth fractures on the third molar in the upper jaw is an accident and is not dependent on size. The genetically determined reduction, on the other hand, seems to be characteristic of dwarf forms. Another bovine mandible remnant from the sample is described below, which belongs to a different spectrum of paleopathological cases. There are archaeological studies and reports dealing with actinomycosis and pseudo joint formations in historical skeletal finds. Signs of actinomycosis, including characteristic bone lesions and pseudojoint formations, were identified. The researchers concluded that these cases may indicate a prevalence of actinomycosis at the time. Such archaeological finds provide insights into past health conditions and diseases in humans and animals. However, it is important to note that interpretation of such findings should always be done cautiously, as different diseases can cause similar symptoms, and modern diagnostic techniques in archeology are limited. A reliable distinction between animal and human bones is a prerequisite (Hunger & Leopold 1978).

The pathogens and the clinical picture of actinomycosis:

Actinomycetes are bacteria that may be responsible for actinomycosis, an infection that causes bone tumors in cattle, particularly on the mandibles. These tumors can be caused by the bacterium Actinomyces bovis. Typical signs include swelling in the jaw area, fistula formation, and the discharge of purulent material. The infection often spreads through injuries in the mouth. In historical times, such an animal disease also carried the risk of becoming a zoonosis. Actinomycosis in humans is a chronic localized or hematogenous anaerobic infection caused by Actinomyces israelii and other species of Actinomyces, according to Bush & Vazquez-Pertejo (2023). The findings include a local abscess with multiple draining sinuses, tuberculosis-like pneumonitis, and mild systemic symptoms. The diagnosis is made based on the characteristic clinical picture plus the laboratory evidence of the pathogen. Therapy today consists of long-term administration of antibiotics and surgical measures. The bone tumors caused by actinomycetes, particularly Actinomyces bovis, manifest as osteolytic lesions on the bovine mandibles. These lesions lead to the destruction of bone tissue and can result in characteristic swelling. As the infection progresses, a purulent fistula often forms that leads through the skin to the outside. This purulent discharge is typical of actinomycosis. The spongy bone growth is evident in the paleopathological findings (Meyer-Borstel 1929).

The genesis of actinomycosis and the paleopathological findings:

The infection often begins through injuries in the mouth, for example through sharp food ingredients such as grass or reed leaves. Actinomycetes are anaerobic bacteria capable of infiltrating surrounding tissue and causing chronic, granulomatous inflammation (plate 1). In actinomycosis, particularly bone tumors on the lower jaws of cattle, pseudojoint formations can occur (Plates 1). These arise from the chronic inflammation and destruction of bone tissue (Plates 1). The actinomycetes lead to abscessing lesions that can manifest as pseudojoints in an advanced stage of infection. These pseudojoint formations arise from the formation of cavities and fistulas in the affected bone area (Plates 1). There may be a connection between these cavities and the outer skin, resulting in purulent discharge (fistula formation). In the present case, it can be assumed that there was a feeding injury in the deciduous tooth stage, as the second permanent premolar was only emerging (plate 1). The height of the jaw in front of P2 is 32 mm. The milk teeth of calves differ from those of adult cows in that they do not contain molars; these are only created in the permanent teeth. In total, the young calves only have 20 teeth before the tooth change. This applies to almost all ruminants, such as goats, sheep, and deer.

4. Conclusions

Descriptions about "Lumpy jaw disease" are scarce in the paleopathological literature. In our data, a neoplastic process can be excluded due to the prominence of tumor cells and the absence of characteristic features of bone tumors that can be noted macroscopically, the so-called palisades sign. Examination of the location of the intraosseous lesion in the mandible and the general diagnosis indicated the possibility of actinomycosis. However, it is not possible to determine whether the cause of the infection is damage to the mucosa or whether the actual disease is periodontitis, which strengthens the immune power of the mouth and causes the disease. Due to its history and classes, the disease prevented animals from reproducing for hundreds of years until the advent of antibiotics.

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Declaration of competing interest

None

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