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Entheseal changes and pathological lesions in draught reindeer skeletons – Four case studies from present-day Siberia

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ABSTRACT

Draught use and being ridden often result in typical pathological patterns in animal skeletons. Moreover, physical activity patterns may be reflected in bone biomechanical properties and entheseal changes at muscle attachment sites. This paper presents the pathologies and entheseal changes observed in four draught and/or racing reindeer skeletons against information on their life histories and discusses the probability of linking the observed changes to their use. The results of this study are a useful point of comparison to researchers working on reindeer and other species of draught animals. However, our results also emphasize that entheseal changes and many pathologies have multifactorial etiologies and that interpretation of skeletal change patterns is not straightforward, even when there is information on the life history of the animal and its complete skeleton can be examined.

1. Introduction

The identification of the use of animals as traction and for riding have been major research topics in zooarchaeology because of their usefulness in understanding animal domestication and the development of agriculture (e.g. de Cupere et al., 2000; Bartosiewicz and Bartosiewicz, 2002; Levine et al., 2005; Thomas, 2008; Pluskowski et al., 2010; Janeczek et al., 2012; Telldahl, 2012). Draught use and riding are often manifested as typical pathological patterns in animal skeletons (e.g. Bartosiewicz et al., 1997; de Cupere et al., 2000; Levine et al., 2005; Thomas, 2008; Telldahl, 2012). Moreover, physical activity patterns may be reflected in bone biomechanical properties (Shackelford et al., 2013) and as entheseal changes at muscle attachment sites (Niinimäki and Salmi, 2016).

Most attention has been paid to cattle and horses (but see Izeta and Cortés, 2006; Shackelford et al., 2013). In the circumpolar area, however, an important resource used for load-pulling, carrying and riding has been reindeer (*Rangifer tarandus*). Reindeer live in the boreal forest and tundra zones of Scandinavia and Siberia. They migrate between forest and tundra areas following favourable environmental conditions and food resources, and they feed on various plants, lichens, and mushrooms. (Nieminen and Pietilä, 1999: 10–11). Adult males weigh 90–180 kg, and females 60–100. Reindeer reach sexual maturity approximately at the age of 1.5 years. Females continue to reproduce until the age of 10–20 years, and males until the age of 10 years and even later (Nieminen and Pietilä, 1999: 15). The lifespan is approximately 18–20 years for females and more than ten years for males (Nieminen and Pietilä, 1999: 15).

Reindeer have been domesticated and used for various purposes in Northern Scandinavia and Siberia. In Scandinavia, the process of reindeer domestication among the indigenous Sámi people may have begun during the Medieval period, but it is clear that reindeer husbandry remained small-scale as part of the subsistence patterns for a long time (e.g. Tegengren, 1952; Hansen and Olsen, 2007; Bjørnstad et al., 2012; Björklund, 2013). It has been argued that the first steps toward reindeer domestication were taken when captive animals were used as decoys in wild reindeer hunting (Tegengren, 1952). Domesticated reindeer, most likely castrated males, were also used in pulling and carrying loads (e.g. Björklund, 2013). In Siberia, reindeer are central to the livelihood of several cultural groups. In addition to use as a food source, reindeer are also used for traction and carrying loads. In Siberia, reindeer are also ridden; training for load-pulling usually begins at age 3, and training for riding at age 4 (V. Davydov, pers. comm.). In Scandinavia, castrated bulls – usually castrated at the age of 3–4 years and trained after that have been used for load-pulling (Nieminen and Pietilä, 1999: 122; Korhonen, 2008: 132–133). At that age, reindeer have not yet reached full skeletal maturity. Epiphyseal fusion in reindeer is completed approximately at the age of 4.5 years for long bones, later

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Table 1
Reindeer individuals used in this study.

Individual	Age (years)	Sex	Est. Weight (kg)	Work use
Yamal individual	11	Male	138	Racing, pulling, carrying
Zhuia River individual	5,5	Male	156	Pulling
Khromoi	13	Male	137	Pulling, riding
Ignatka	13	Male	147	Pulling, carrying, riding

for vertebrae (Takken-Beijersbergen and Hufthammer, 2012). Also, body weight increases until the age of about 4–5 years in females and 5.5 or more years in males (Nieminen and Petersson, 1990).

The aim of this study is to present the observed pathologies and entheseal changes in the skeletons of four draught reindeer originating from present-day Siberia. We connect the observed pathologies and entheseal changes to the known, detailed life histories and physical activity patterns of these animals. We will discuss the possibility of connecting the observed changes to their physical activity patterns. The results of this study will be useful points of comparison for researchers working on reindeer and other species of draught animals.

2. Material

The material of this study consists of skeletons of four reindeer from different regions of Siberia (Table 1). These reindeer were used for pulling and carrying loads, two also for riding. The skeletons were collected by Vladimir Davydov, Dmitrii Arziutov and Evgenii Ineshin during ethnographic fieldwork in Siberia in 2012–2014. During fieldwork, the animals' life histories were recorded by interviewing the owner and other people in the community. The reindeer were old cargo and riding reindeer at the end of their working careers, destined for slaughter. The skeletons of Ignatka and Khromoi are housed at the Kunstkamera in St. Petersburg; the Zhuia River and Yamal individuals in Irkutsk.

Measurements of humerus greatest length and trochlear height were taken to reconstruct weight (von den Driesch 1976; Puputti and Niskanen, 2008). Both bone characteristics are fairly accurate in predicting weight of especially male reindeer (Puputti and Niskanen, 2008). Weight was reconstructed using estimation equations for both humerus greatest length and trochlea height, and mean weight of these estimations was used to represent weight. All skeletal elements of the Zhuia River, Khromoi and Ignatka remains were photographed individually. For the Yamal reindeer, only 3D scanned bone material was available for study. The pathological features of Khromoi and Ignatka were scored on the bones. The Zhuia River reindeer's pathological features were scored based on photos and field notes provided by Robert Losey. In addition, long bones, including metapodial bones, of the Yamal and Zhuia River individuals were 3D laser scanned for entheseal scoring. The entheseal changes in the skeletons of Ignatka and Khromoi were scored on the bones. The 3D scans were in PLY and CTR format and were observed using the OPTOCAT 2011 R program. The quality of the scans was sufficient to record new bone formation at muscle attachment sites (Niinimäki and Salmi, 2016) but not pitting or erosion, and thus they were not used for scoring of pathological features.

2.1. Yamal individual

The Yamal individual originated from the Yamal Peninsula in arctic Western Siberia. He was an 11-year-old castrated male. The animal's weight estimated from long bone lengths, following the equation in Puputti and Niskanen (2008), was ca. 138 kg. The animal had worked ca. 10 years. He was a champion racing reindeer. In addition to pulling during racing, he was also used for pulling sledges and carrying loads (up to 250 kg) on his back.

2.2. Zhuia River individual

The Zhuia River individual came from the Zhuia River region of eastern Siberia. He was a 5-and-a-half-year-old male. His weight was estimated from long bone measurements to be approximately 156 kg. He had been one in a group of four reindeer used by his owners (of the Evenki cultural group) for pulling sleds. The sled would typically carry as much as 150 kg.

2.3. Khromoi

Khromoi was a ca. 13-year-old male reindeer from the Popigai village on the Taimyr Peninsula. The animal's estimated weight was 137 kg. He belonged to Aleksei Spiridonovich Bol'shakov of the Dolgan cultural group. Khromoi was used for riding and pulling loads. During the summers he was used as a riding reindeer for Aleksei Spiridonovich's teenage daughter. The reindeer got his name Khromoi, meaning "Lame" in Russian, due to an injured left hind limb, although how and when the injury occurred is not known. People told that his leg had become disabled not too long ago. He was slaughtered in autumn 2014 because of the leg injury.

2.4. Ignatka

Ignatka was a 13-year-old male reindeer with an estimated weight of ca. 147 kg from the Kust'-Kemda village in the Verkhnii Sakukan River valley in the Kalarskii Raion, Zabaikal'skii krai. He belonged to Iurii Iur'evich Mal'chakitov, of the Evenki cultural group. He was used for riding, pulling and carrying loads. Ignatka's owner was a relatively heavy man (ca. 95 kg), while the Evenkis in this area usually recommend that people weighing more than 70 kg should not ride reindeer. Perhaps due to the heaviness of his owner, Ignatka's back had been severely affected. The owner knew he had back problems. However, the owner felt that Ignatka was very strong in comparison to other reindeer, and he had been working until the year he was slaughtered. Ignatka's owner was surprised to see the extent of damage in Ignatka's vertebrae at slaughter. Ignatka had been castrated at the age of three.

3. Methods

3.1. Pathological features

The interpretation of skeletal pathologies and changes in bone morphology is complicated. The etiology of many of those pathologies associated with draught use is unclear and undoubtedly multifactorial. For instance, age, sex, size, and various environmental factors are known to affect the prevalence of pathological lesions in the animal skeleton (e.g. de Cupere et al., 2000; Thomas, 2008; Flensborg and Kaufmann, 2012; Telldahl, 2012). Therefore, although many types of pathologies are often associated with draught use or riding in the zooarchaeological literature, their association with animal activity is far from explicit.

Analysis of skeletal changes in oxen with a known history of draught use suggests that certain pathologies are often encountered in draught animals (Bartosiewicz et al., 1997). Pathological changes observed frequently with draught use in cattle are