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OSTEOLOGICAL EVIDENCES OF BYZANTINE DRAUGHT CATTLE FROM THEODOSIUS HARBOUR AT YENİKAPI, ISTANBUL

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ABSTRACT

In this study, pathologies referred to Byzantine period cattle used as draught animals which are discovered in Istanbul Yenikapı Metro and Marmaray Excavation are reviewed. As a result of this review, it is determined that cows and bulls are used as draught animals for their workforce and thereupon some pathologies are determined on their extremity bones and posterior parts of their skull. These are symptoms like metapodial asymmetry, proximal, distal and peripheral exostoses, metapodial and cornual depressions, distal lipping, nuchal perforation and dehorning. The skeleton remains of Yenikapı cattle belong to young and old cattle, but it is determined that the individuals with these pathologies are elder ones. The individuals demonstrating these pathologies are both male and female cattle, so it is understood that the animals exploited for draught power are not only bulls, but the females were also used for pulling.

KEYWORDS: draught cattle, Theodosius Harbour, Yenikapı-Istanbul.

1. INTRODUCTION

The remains of cattle skeletons are among the most abundant animal bones in most sites since the Neolithic Age. Therefore, these remains are the osteological materials which are high potential evidence that cattle are not only used as food, but also as draught animals (De Cupere et al., 2000). Generally, archaeozoological studies make reference to cattle' production of meat and milk (De Cupere and Waelkens, 2002; Groot, 2005; Koepke and Baten, 2007), but it is rarely stated that these animals are used as draught animals (De Cupere and Waelkens, 2002). Cattle are probably the first large animals used for draught (Davis, 1987). It is indicated that they are used regularly in agriculture systems in Europe during the Bronze Age (quoted by Telldahl, 2005). Cattle breeding are generally a multipurpose work like the production of meat, milk, manure and pulling power (Bartosiewicz et al., 1997; Groot, 2005; Telldahl, 2005; Koepke and Baten, 2007). Answers of multiple questions i.e. have animals been used for their meat and milk, or as draught animals to use their pulling capability were sought by examining the archaeozoological cattle remains (Koepke and Baten, 2007). Apart the archaeozoological remains, the literary sources are other possible indications of using cattle as draught animals are. In these sources (e.g. Greek Animal Husbandry) however it is only possible to obtain very limited knowledge (De Cupere and Wealkens, 2002). Roman agronomists, such as Columella (*De re rustica* 2.2.1.5; 2.2.24; 6.22.1), Varro (*Res rusticae* 1.20.2, 4-5) and Cato (*De agricultura* 11.2.4;14.2; 62) mentioned that cattle, especially bulls are used as draught animals (Toynbee, 1983; De Cupere and Waelkens, 2002; Onar et al., 2012; 2015b; Marković et al., 2014). Cattle make the most important contribution to local economy in the rural residential area they are living in (Groot, 2005). This feature comes from its multipurpose use (meat, milk, manure, power). One of the biggest problems, however, always is to make archaeozoologists think if these animals were used for their pulling strength besides being a source of meat, milk, manure or not, or about how they were used in agriculture, or for which type of labour they were used in the aforementioned settlements (Groot, 2005; Koepke and Baten, 2007).

When an animal is used for work, this makes a deep impact on its body and the reaction of the body is a different one. Animals can sustain the weight they carry by their nature and are able to handle this with a series of methods. The first reaction in the musculoskeletal system comes from muscles and the muscles tolerate overstress. If the animal cannot tolerate this stress with its muscles, and the body is chronically under stress, then emergence of bone pathology would possibly develop as a reaction of the body (Björnhag et al., 1989; Telldahl, 2005).

Because the amount of cattle bones in the remains is too much, it is possible to make a detailed analysis of the pathologies of these bones (De Cupere et al., 2000). So, documenting the needed osteological evidence for the use of cattle as draught animals is an important approach.

Some pathology in the skeleton is related to draught exploitation (Bartosiewicz et al., 1997; De Cupere et al., 2000; De Cupere and Waelkens, 2002; Isaakidou, 2006; O'Connor, 2008; Telldahl, 2005; Tourunen, 2008). Some of the pathologies observed in the appendicular skeleton are exostoses in the scapula and vertebrae; eburnation in the pelvic acetabulum and caput femoris; lipping and exostoses on the proximal joint surfaces of metapodial and phalanges; enlargement and asymmetry of the distal epiphyses of metapodials, palmar and distal depressions metapodia, sometimes exostoses around the diaphysis and accompanied grooving of the articular surface (Armour-Chelou and Clutton-Brock, 1985; Baker and Brothwell, 1980; Bartosiewicz, 2008; Bartosiewicz et al., 1997; De Cupere et al., 2000; De Cupere and Waelkens, 2002; Groot, 2005; Issakidou, 2006; O'Connor, 2008).

In addition to pathologies observed in the appendicular skeleton, some pathologies in the skull because of yoking the animals, are mentioned. These are the depressions of yoke on horn cores (Benecke, 1994; De Cupere et al., 2000) and perforations in nuchal region (some other factors are also mentioned for the etiology of these holes) (Baker and Brothwell, 1980; Baxter, 2002; Brothwell et al., 1996; De Cupere et al., 2000; Llado et al., 2008).

Four osteological criteria used in diagnosis of osteoarthritis are mentioned in animal paleopathology. These are formation of grooving on articular surface, eburnation, enlargement of articular surface with the formation of new bone and exostoses on the periphery of the bone. If three of these criteria are detected on the same bone, then osteoarthritis may be diagnosed (Baker and Brothwell, 1980). These paleopathological assessments should be made by considering the animal's age (De Cupere et al., 2000; De Cupere and Waelkens, 2002), sex (De Cupere et al., 2000; Groot, 2005; Telldahl et al., 2011), intended use (Bartosiewicz, 2008; Bartosiewicz et al., 1993; Bartosiewicz et al., 1997; De Cupere et al., 2000; De Cupere and Waelkens, 2002; De Cupere and Waelkens, 2002; Telldahl, 2005; O'Connor, 2008; Marković et al., 2014) and the topography of the region it is living in (De Cupere et al., 2000).

In some of the archaeological sites of Anatolia, (e.g. Demircihöyük, Boğazköy-Hattuşa, Sirkeli Höyük, Lidar Höyük and Sagalassos) a limited number of pathologies related to the use of cattle as draught animals are mentioned (De Cupere and Waelkens, 2002; von den Driesch and Boessneck, 1981; Rauh, 1981; Kussinger, 1988; Vogler, 1997). At Sagalassos, one of the mentioned sites, metapodial and phalangeal pathologies of draught cattle during Roman period are described in detail (Bartosiewicz et al., 1997) used on the modern draught bulls was applied for the first time on archaeological remains. Our study examines the remains of Byzantine period cattle revealed in Yenikapı, the main station of metro rail system and Marmaray undersea rail tunnel. Archaeological excavation studies has been carried out under the name of "Yenikapı Metro and Marmaray Excavation" by the presidency of Directorate of Istanbul Archaeological Museums in 2004 and continued successfully until the end of 2013. The findings from the excavations made it clear that this place was the ancient Theodosius Harbour (Müller-Wiener 1998), known as "Portus Theodosiacus" built by emperor Theodosius I (A.D. 379-395) and known as "Langa" or "Vlanga" (called Langa Bostanları as its Turkish name) in the Ottoman period. Although this excavation area of 58.000 m^2 is in two different projects (Metro and Marmaray), the zooarchaeological studies continued without any borders in the same area until today and its results were examined as a whole. In this study, the skeleton pathologies related to the use of Byzantine period (Onar et al., 2008) cattle as draught animals discovered in Yenikapı Metro and Marmaray Excavations are presented.

2. MATERIALS AND METHODS

During the Marmaray excavation, many archaeological artefacts and many bones from cattle, horse, sheep, goat, dog and pig skeletons were found and the results were published in previous studies of ours (Onar et al., 2013a; 2013b; 2013c; 2015a; Pazvant et al., 2015). All bones found in the area were taken to Istanbul University Veterinary Faculty, Department of Anatomy, Osteoarchaeology Laboratory to be examined with permission granted by the Ministry of Culture and Tourism. The examinations continued until 2010 within the project supported by TÜBİTAK (Project Number: 107O518). Because the excavation area is too big and consists of too many archaeological materials, excavation studies continued until October, 2013. The remains of Byzantine period cattle used in this study are discovered in the excavation studies made between 2010 and 2013.

In this study, total 4739 bovine bone remains (NISP=4739) were investigated. Among these bones, the pathologies attributed as evidences showing the use of

cattle for draught purposes such as cornual depression, nuchal perforation, dehorning and distal extremity pathologies (metapodial asymmetry and depressions, metapodial and phalangeal exostoses) were evaluated by considering the age and sex differences of individual animals.

3. RESULTS

Although cattle skeleton remains were found in different depositional levels in the whole region, a whole cattle skeleton *in situ* could not be found in Theodosius Harbour area. The cattle skeleton remains discovered in the area are 20.16% of all the bones examined (NISP=4739). Pathologic symptoms were seen on 7.13% of all the cattle bones examined. 26.92% of remains exhibited pathologies referred to the use of cattle as draught animals and 73.08% had other pathologies (e.g. of teeth and mouth region). The range of these pathologies can be seen on Fig. 1.

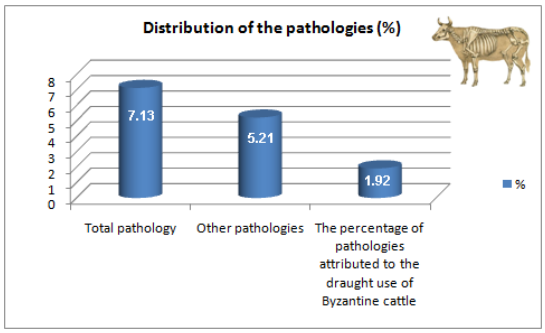

Figure 1. The range of skeleton pathologies among Yenikapı Byzantine cattle (%).

The pathologies determined on Byzantine cattle with draught exploitation were metapodial asymmetry, proximal, distal and peripheral exostoses, metapodial and cornual depressions, distal lipping, nuchal perforation and dehorning symptoms (Fig. 2).

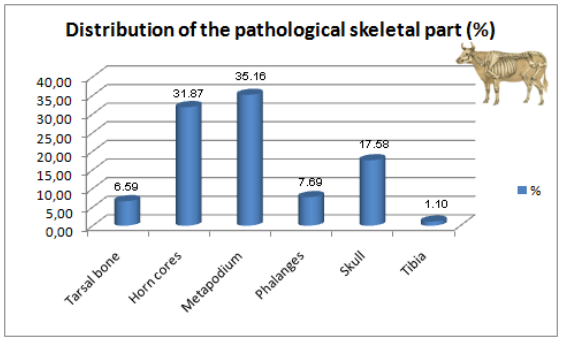

Figure 2. The range of pathologies observed on Yenikapı Byzantine cattle according to skeleton parts.

Pathologies referred to the use of cattle as draught animals were seen mostly (35.16%) on metapodia (Fig. 3), followed by the cornual depression symptom on horn cores (Fig. 4). Dehorning symptoms were seen on two cases (Fig. 4). This is not a natural pathologic sign but one made by man. Nuchal perforations have been detected on the skull, possibly due to yoking the animal (Fig. 5). It was observed that these perforations on the nuchal parts of the posterior portion of the cattle skulls were circular and oval and were ante mortem.

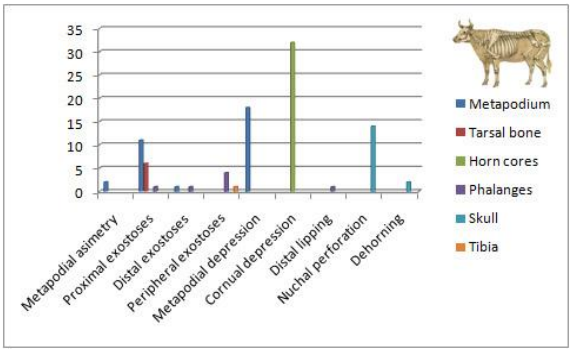

Figure 3. The range of skeleton parts on Yenikapı Byzantine cattle, on which skeleton pathologies were observed (%).

Figure 4. Cornual depression (above, shown with an arrow) and dehorning symptom (below) on Yenikapı Byzantine cattle.

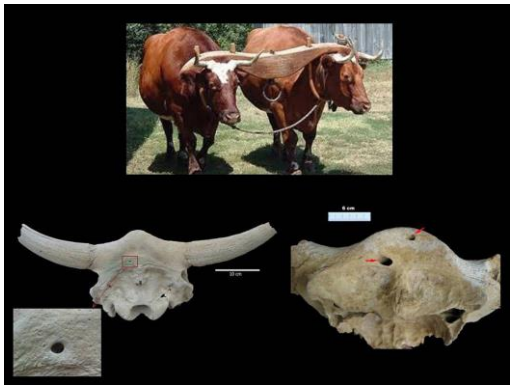

Figure 5. Nuchal perforations on Yenikapı Byzantine cattles. Picture above:

http://jennifermcdonaldwrites.files.wordpress.com/2012/10/ox-yoke.jpg. Pictures below: V.ONAR

The depressions observed on the metapodia were just above the distal epiphysis and on the palmar or plantar side of the bone and rather symmetric (Fig. 6). Metapodial asymmetry was seen on two cases. It was detected by enlargement of medical trochlea on the distal edge of one metacarpus and one metatarsus. There were proximal exostoses on eleven metapodia and distal exostoses on one metacarpal bone (Fig. 7). Pathologies were detected on seven phalanges (ph1=6; ph2=1) (Fig. 8). These were proximal and distal exostoses, proximal lipping and peripheral exostoses. The only pathology seen on ph2 was peripheral exostoses. The diaphyseal part of one left tibia with butchery marks on it had exostoses on its lateral part.

Figure 6. The depressions (metapodial depressions) observed on Yenikapı cattle metacarpus. (Photo by: V.ONAR).

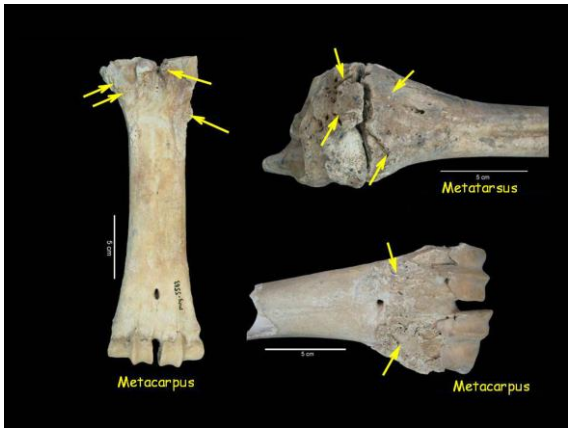

Figure 7. Exostoses (osseous reproduction) observed on metapodia belonging to Yenikapı cattle. (Photo by: V.ONAR).

Figure 8. Proximal exostoses and distal lipping observed on phalanx prima belonging to Yenikapı cattle. (Photo by: V.ONAR).

4. DISCUSSION

Cattle are among the most important animal contributing to the local economy they are living in. These animals are bred not only for their milk and meat, but also for their secondary products like manure and workforce (Groot, 2005; Isaakidou, 2006). Therefore, it is mentioned that the cattle skeleton remains are the most common animal bone remains since the Neolithic age (De Cupere et al., 2000). While the animal bone studies basically focus on the use of

these animals for food production, draught exploitation is mostly documented by pictorial evidence, archaeological pieces, objects and sculptures on which the use of cattle as draught animals pulling plough and wagon are depicted (De Cupere et al., 2000; De Cupere and Waelkens, 2002).

Pathologic symptoms have been seen on 7.13% of the examined cattle bones in our study. 26.92% of these pathologies were pathologies from the use of cattle as draught animals. All these bones were skeleton remains of adult individuals. Generally, pathologies on the distal extremity bones (metapodium and phalanx) related to pulling were detected on Yenikapı Byzantine cattle. Other skeleton pathologies i.e. of the scapula and pelvic acetabulum (Armour-Chelou and Clutton-Brock, 1985; Groot, 2005) were not detected in our study yet. Exostoses symptoms are seen only on one tibia around diaphysis.

The age and sex of the animals is one of the subjects which was emphasized most on pathological reviews on draught exploitation, (De Cupere et al., 2000; De Cupere and Waelkens, 2002; Groot, 2005). A strong connection between age and pathology frequency was generally mentioned in archaeologic examples (De Cupere and Waelkens, 2002). However, it is mentioned that there is positive correlation between body weight and pathological index (Bartosiewicz et al., 1997) and osteoarthritis is reported to be more common on heavy races (Vaughan, 1960). In our study, all of the pathologies related to pulling belonged to adult individuals. Therefore, it is thought that the pulling power of cattle was used until they are old.

In our study, no osteoarthritic changes were observed on bones of shoulder and hip (such as scapula, humerus, acetabulum pelvis and femur). The pathologies observed belonged only to distally located extremity bones.

The use of cattle as draught animals in Roman period is documented very well historically (Groot, 2005). The use of cows also for draught beside bull has been suggested and presence of osteological findings for this opinion was mentioned (Groot, 2005; Telldahl et al., 2011). The age and sex range of the cattle butchered in the settlement can be used as complementary evidence for the exploitation of animal power (De Cupere at al., 2000). Because the young animals are used for their meat, it can be accepted that elderly animals are used for their milk or physical power (De Cupere at al., 2000; Koepke and Baten, 2007). The remains of the cattle skeletons in the Yenikapı Metro and Marmaray Excavation are 20.16 percent of all the bones examined (Onar et al., 2013a). Many traces of butchery were observed on these remains and it was determined that these were residuals of consumption (Onar et al., 2013a; 2013b). It is determined that the skeleton remains of cattle are of individuals of different age groups from young to elderly ones, but the individuals with pathology are elderly ones. It can be seen that the individuals with this pathology are both female and male and especially it is clear that the individuals with nuchal perforation on their skulls are females. Besides, the pathologies observed on the postcranial skeleton and the pathologies caused by yoking the animals can also be discussed. These are the depressions on the horn cores caused by the yoke (Benecke, 1994; De Cupere et al., 2000) and perforations on nuchal region (Baker and Brothwell, 1980; Baxter, 2002; Brothwell et al., 1996; De Cupere et al., 2000; Llado et al., 2008). Possible etiological factors of these perforations (Brothwell et al., 1996) on the posterior portion of archaeologic cattle skulls and nuchal portion were discussed by various writers (Baxter, 2002; Brothwell et al., 1996) and according to the reviews, even the parasites, tumours and infections are seen as possible causes (Brothwell et al., 1996), congenital factors and the pressure of yoking on the neck are said to be other possible reasons (Baxter, 2002; Brothwell et al., 1996; De Cupere et al., 2000; Llado et al., 2008). Especially, the pressure of yoke and its addition parts make on the roots of the horn can cause an acute inflammation (Ryder, 1970). The existence of depression on the

horn cores and holes in the nuchal region on the skull examples of the female and male individuals determined ante mortem in the Yenikapı excavation area; suggest that these animals were used for pulling. Besides stating different aetiologies of cornual depressions (Albarella, 1995) and nuchal perforations (Brothwell et al., 1996), it is thought that especially the pathologies of lower extremities are indications of draught exploitation. Because cattle are characterized with diagonal steps and have functional differences between forelegs and hind legs, a different reaction to stress and tension between forelegs and hind legs could possibly exist (Bartosiewicz, 2008). There were not observed difference in the number of pathologies at the fore and hind limbs of Byzantine Cattle at Yenikapı, it is thought, the use of these animals at extremely hard works had caused these pathologies.

A scoring system was developed on bulls (Bartosiewicz et al., 1997) and used successfully in the review of archaeological examples (De Cupere et al., 2000; De Cupere and Waelkens, 2002). The number of phalanges with pathologic symptoms in Yenikapı excavations is only seven. Hence, no scoring system review was made on this limited number of bones.

The topography of the area the animal is living in, is also seen as another effective factor in the review of extremity pathologies. For example, it is thought that the topography may be an effective factor on the development of the pathologies observed in extremities of animals living in the rough and rocky areas like Sagalossos (De Cupere et al., 2000). The cattle remains we used in our study were taken from Theodosius Harbour area which is one of the most famous harbours in the coast of Marmara in Constantinople, the capital city of Byzantine Empire. It is thought that the above mentioned remains are probably of ploughing in agricultural lands around the city or belongs to animals used for pulling wagons (carrying load) in city life.

5. CONCLUSION

Although Yenikapı Metro and Marmaray Excavation were finished in 2013, laboratory studies are going on and these studies will take long years. The examination of remains of animals is still going on and we believe that our discoveries will be supported by the archaeological excavations which may be made in the other parts of the city. If the range and localization of pathologies related to draught exploitation and the age and the sex of animals and the topography of the region are considered, it is suggested that Yenikapı Byzantine cattle are not bred only for their milk and meat, but also used for their workforce and it may be seen that pathologic symptoms from draught exploitation also existed in Byzantine Empire. Although the amount of the remains of equids (horse, donkey and mule) cannot be underestimated (Onar et al., 2012; 2013a; 2013b; 2013c; 2015b) among the animal population in Yenikapı excavation area, we see that both female cattle and bulls were used as draught animals as a continuation of the Roman tradition.

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