# BONE EVIDENCE OF PATHOLOGICAL LESIONS IN DOMESTIC HEN (*Gallus domesticus* Linnaeus, 1758)

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**Summary.** This paper presents bone evidence for various pathological lesions occurring in domestic hen (*Gallus domesticus* L.), the first domesticated bird. They include healed fractures of a small grade exacerbated by dislocations, inflammations manifested in joints, *osteopetrosis*, cervical hernia and rickets. All but one of the illustrated specimens originate from archaeological assemblages found on the territory of the present day Hungary and Romania. The time period represented by the finds ranges from the Roman Empire to the Middle Ages. In addition to the illustration of pathological lesions, a short description of the origin and effect of the injuries is given.
**Keywords:** bone pathology, domestic hen, archaeological assemblage, Hungary, Romania.

# NAMINIŲ VIŠTŲ (*Gallus domesticus* Linnaeus, 1758) KAULŲ PATOLOGINIAI POKYČIAI

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**Santrauka.** Straipsnyje aprašomi įvairūs pirmojo prijaukinto paukščio – vištos (*Gallus domesticus* Linnaeus, 1758) – griaučių patologiniai pokyčiai: sugiję nedideli kaulų lūžiai, kopmplikavęsi išnirimais, sąnarių uždegimai, osteopetrozė, kaklo išvaržos ir rachitas. Visi patologijų atvejai, išskyrus vieną, rasti dabartinių Vengrijos ir Rumunijos teritorijų archeologiniuose paminkluose. Kaulų patologijos datuojamos nuo romėniškojo periodo iki viduramžių laikotarpio. Straipsnyje trumpai apibūdinami patologijų kilmė ir poveikis.
**Raktažodžiai:** kaulų patologija, naminė višta, archeologiniai paminklai, Vengrija, Rumunija.

**Introduction.** Domestic hen (*Gallus domesticus* Linnaeus, 1758) was the earliest domesticated bird, of which taming took place is Asia (West and Zhou 1988). It is supposed that the Celts were responsible for the spread of the domestic hen, while Greeks and Romans kept it in larger numbers and started its conscious breeding (Bökönyi 1985). Greek colonies introduced the domestic hen to the Southern- and Western Mediterranean; the first archaeological evidence comes from Greek Period sites in Sicily (Di Rosa 2003) and the Iberian Peninsula (Garcia Petit 2005). In Central Europe, the first hen remains have been found in settlements and graves dated to the late Hallstatt Period of the Iron Age (Benecke 1993).

As the earliest fowl tamed and kept by people, domestic hen has been exposed to various physical and physiological trials resulting from animal husbandry. It is not accidental, therefore, that most of the archaeological avian remains exhibiting pathological lesions belong to this species. Nevertheless, few examples have been published and especially illustrated so far. They usually outline the most spectacular cases such as cerebral hernia (Brothwell 1979) and *osteopetrosis gallinarum* (Baker and Brothwell 1980: 6060-62, Fig. 9; Fabiš 1997; Brothwell 2002).

After presenting bone pathologies observed both on the skeletal parts of wild and domestic birds in the Proceedings of the last meeting of the ICAZ Animal Palaeopathology Working Group at Nitra, Slovakia (Gál forthcoming), this time I shall concentrate on those pathological conditions typically observed in domestic hen. Evidence from Hungary and Romania, dating from the Roman Period to the Middle Ages, includes a number of finds showing traces of various mechanical and infected traumas as well as a genetic disorder and a disease of the metabolic system.

**Material and Methods**

Avian remains are usually under-represented in archaeological assemblages due to the modest economic importance of fowl in comparison with mammals, and the pre- and post-depositional taphonomic factors influencing the small and fragile skeletal parts. Bird bones displaying pathological lesions are even fewer (Gál forthcoming, Table 1). Nevertheless, domestic hen has been present from the end of the Iron Age as the earliest domestic fowl in Europe. Since then, although goose, duck and other few species also have been domesticated or tamed, it has remained the most preferred poultry all over Europe. The increasing frequency of remains from domestic hen may especially be observed in Roman and Medieval archaeozoological assemblages.

Excavations carried out in the last decades both in Hungary and Romania have yielded a number of remains from domestic hen. Some of these displayed various pathological conditions. All the skeletal parts under study belonged to adult individuals. The archaeological age of finds ranged from the period of the Roman Empire to the Middle Ages. Data on the chronological and geographic distribution of the specimens under study is summarised in Fig. 1 and Table 1.

The identification of bones was made by using recent comparative bone collections. I followed the specialist literature and consulted with archaeozoology and veterinary colleagues when diagnosing the lesions.


Fig. 1. **Map indicating the sites that yielded hen remains with pathological conditions from Hungary and Romania**

Table 1. **Summary of the cases discussed in the text and illustrated on the map**

| No. of site | Name of site | Country | Settlement type | Age | Pathological condition | Skeletal part affected |
|---|---|---|---|---|---|---|
| 1 | Intercisa | Hungary | Military camp | Roman Period | Simple fracture | Humerus and tibiotarus |
| | | | | | Bone necrosis | Humerus |
| | | | | | *Osteopetrosis* | Tibiotarsus |
| 2 | Kiskundorozsma | Hungary | Settlement | Avar Period | Heavy fracture | Scapula and femur |
| 3 | Oltina | Romania | Village | Early Middle Ages | Bone necrosis | Tarsometatarsus |
| 4 | Buda | Hungary | Capital | Middle Ages | *Osteopetrosis* | Skeleton |
| | | | | | Cerebral hernia | Cranium |
| 5 | Székesfehérvár | Hungary | Town | Middle Ages | Rickets | Sterni |
| 6 | Pilisszentkereszt | Hungary | Monastery | Late Middle Ages | Simple fracture | Femur |

**Results and discussion**

Simple fractures

Fractures are due to mechanical interactions with other animals, people or accidents in the natural or artificial environment. According to the damage caused to the bone, simple and heavy fractures may be separated. Simple fractures are small injuries in which the ends of the broken skeletal parts do not move (much) from each other. The healing usually takes place in a short time and causes little distortion to the bone.

Healed fractures of a small grade could be observed on three specimens under study. A left humerus and a left tibiotarsus from the Roman site of Intercisa on the Pannonian *limes* (Fig. 2), and a left femur from the late medieval monastery of Pilisszentkereszt in Hungary (Fig. 3) displayed marks of simple fractures. It is likely that no infection or other complication affected the lesions, since the remodelled callus is small and the degree of deformation is limited.

Heavy fractures

Heavy fractures vary from the previous category by the gravity of the damage endured. The ends of the broken bone(s) usually move from each other in this cases and lead to dislocations. If the muscles can keep together the broken bones, the healing may happen by forming a large callus bridge between the fragments.

A left scapula and a left femur from the Avar Period settlements Kiskundorozsma–Tóth János dombja and Kiskundorozsma–Daruhalom-dűlő in Hungary, respectively (Fig. 4), showed serious fractures followed by dislocations. These heavy breakages healed by developing callus bridges, and resulted in the distortion and size-decrease of the affected skeletal parts.

At the beginning of the 20th century, a number of fractures were identified on the bones of different gallinaceous species from Pleistocene assemblages in Hungary. Not only the long bones, but skeletal parts well embedded into muscles such as the clavicle were also affected in substantial numbers. The frequency of fractures in those birds was interpreted as due to intra-specific conflicts related to the fighting of males during the mating period and territory defence (Lambrecht 1933: 883-886, Fig. 200).


Fig. 2. **Humerus and tibiotarsus showing simple fractures**

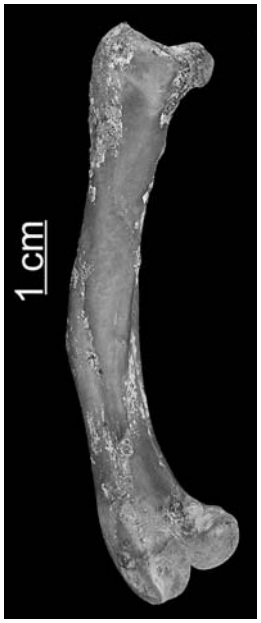


Fig. 3. **Simple fracture on a femur**

This kind of behaviour is characteristic of male galliforms. Cock-fighting along with quail- and partridge-fighting were favourite sports among the Greeks (Morgan 1975). They introduced this sport to Rome, while Rome diffused it into the whole empire. The cocks of domestic hen were armed with steel- and bronze spurs called *plectra* by their owners. Cock fighting was practiced in Europe as late as the 19th century as evidenced not only by metal spurs bound to the foot of birds, but also by the sawn off natural spurs on tarsometatarsi. This latter process made the attachment of artificial spurs easier (West 1982).


Fig. 4. **Scapula and femur showing fracture with dislocation and healed by callus formation**

Bone necrosis

Examples of bone necrosis of different severity were identified in two specimens (Fig. 5). Minor traumatic damage probably caused the rupture of small periosteal vessels in the case of the left humerus found at the Roman site of Intercisa. The healing was relatively uncomplicated with no heavy infection, although distortion of the bone followed this trauma (Fig. 5 left).


Fig. 5. **Humerus and tarsometatarsus displaying bone necrosis**

It is likely that the digits of the cock had been sloughed off in the case of the right tarsometatarsus found at the 10th–11th century settlement Oltina in South-Romania (Fig. 5 right). This was followed by the infection of the distal part of the tarsometatarsus which caused

a pronounced pathological lesion. The proximal epiphysis is missing in this fragment which makes its evaluation more difficult. Nevertheless, the slightly deformed diaphysis would suggest that the bird was affected at a young age and the weight of the body pressing the mangled foot resulted in the twisting of the bone shaft.

*Osteopetrosis*

Osteopetrosis is caused by the chronic action of avian leucosis virus group (ALV) belonging to the family of Retroviridae. The disease, as its name *osteopetrosis gallinarum* implies, is typical of domestic hen. It spreads among young domestic fowl and causes the accretional growth of bones through abnormal osteoblast activity. Interestingly enough, only the diaphyses thicken in the case of long bones, the epiphyses remain unaffected.

Archaeological evidence from the Great Britain (Brothwell 2002), France, Turkey (Fabiš 1997) and Hungary (Fig. 6) indicates that *osteopetrosis* has affected birds since the Roman Period. The latter example found along the Pannonian *limes* is one of the easternmost data considering the spread of this condition in the period of the Roman Empire.

A partial skeleton from hen found in the medieval capital of Hungary, Buda, represents the most complete archaeozoological evidence for *osteopetrosis*. The skeletal parts including the sternum, the humeri, the ulnae, a radius, a femur and the tibiotarsi (Fig. 7) indicated that both flat and long bones were affected by this condition. Due to the number of bones belonging to the same individual, this specimen probably brings another important data to the recognition of *osteopetrosis*. It has been supposed that the disease starts in the tibiotarsus and extends to the rest of body (Baker and Brothwell 1980: 61). However, if one hypothesises that the earliest affected bone(s) should display the most expansion, the specimen from Hungary indicates that osteopetrosis may begin in the breast or wings alike, and that the legs could be one of the latest affected skeletal parts (Fig. 7).


Fig. 6. **Tibiotarsus showing osteopetrosis**


Fig. 7. **Partial skeleton (sternum, humeri, ulnae, radius, femur and tibiotarsi) showing osteopetrosis**

Cerebral hernia

Cerebral hernia is the result of abnormal brain grown generated by a deficient gene. As the condition affects chickens from the very beginning of their life, the growth of the skull tends to follow the expansion of the cerebral hemisphere into an enlarged frontal area, resulting in a deformed and perforated cranium. In accordance, the crest and tuft placed on the partially osseous and partially membranous skull changes the appearance of these birds. This feature has been promoted by keepers and ultimately resulted in a special breed, named the crested hen. Polish-, Silkie- and Hudan chicken are the most commonly known breeds within this type.

As it was referred to in the extract from the Proceedings of the Zoological Society of London of 25th November 1856 (Tegetmeier 1856: 366-368), the disease was already noted by Peter Borelli in 1656, and erroneously described by Blumenbach in 'De Nisus formative Aberrationibus', in 1813. The tuberosity was thought to only manifest itself in female birds and was caused by the tight constriction of the integuments, resulting in a "remarkable stupidity" of the fowl. It also was hypothesised by Pallas that the crested hen was a result of a cross with the helmeted Guinea fowl (*Numidia meleagris* L.).

Nevertheless, the genetics of the cerebral hernia was considered only at the beginning of the 20th century (Fischer 1934). Recent allometric comparisons made by the Brain Research Institute in Germany in order to study the influence of body weight to brain size, indicated that some brain structures (the optic tract for example) were significantly larger in crested hen than in seven uncrested breeds (Frahm and Rehkämper 1998). Similar studies were also carried out on crested domestic duck as well. However, one should not expect to discover similar archaeological evidence to the crested hen, since in ducks the crest is lying on a cushion of fat nourished by brain vessels (Frahm et al. 2001).

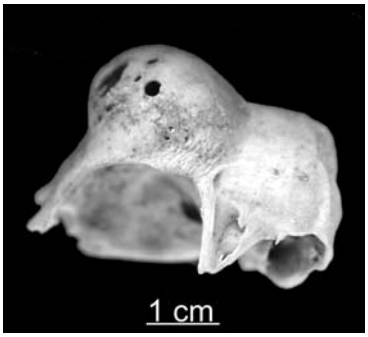


Fig. 8. **Skull with enlarged and perforated frontal area due to cerebral hernia**

Several years after the Roman Period find from Great Britain (Brothwell 1979), new archaeological evidence for cerebral hernia associated with crested hen has been found. The well preserved neurocranium showing the typical signs of the hereditary disease (Fig. 8) originates from the site of Szentgyörgy Square in the castle of Budapest. It confirms the presence of this rare breed already in the medieval capital of Hungary.

Rickets

Rickets is a metabolic bone disturbance in young birds due to the imbalance of calcium, phosphorous and Vitamin D that stimulates calcium absorption. It is a rather frequent condition among domestic fowl related to insufficient feeding and the crowded conditions of caged birds. The affected skeletal parts become curved owing to the softened (demineralised) condition of bones and the increasing weight of the body in the developing animal.

A series of twisted sterni attributed to rickets were found at the medieval town of Székesfehérvár–Csók Street in Hungary (Fig. 9). Since it is likely that poultry at those times were kept in natural conditions, which included the possibility of perching for chicken, it has been supposed that both poor feeding and systematic perching caused the twisting of bones. Experiments on the effect of nesting, dust bathing and perching by laying hens in cages to their behaviour and welfare showed that the keel bone depressions appeared to be associated with perches in 43% of hens. Hens spent one quarter of the daytime on the perch, while most of them (90-94%) roosted on the perch during the night. It is likely, however, that perching combined with osteoporosis – a disease in which the bone mineral density is also reduced – caused the twisted sterni (Appleby et al. 1993).

Rickets was also identified on a pair of curved tibiotarsi from a recent hen bred in an artificial environment. Although the incompletely ossified epiphyses of bones have been almost entirely gnawed off by a domestic cat, the curved shafts of tibiotarsi clearly show that the skeletal parts of both sides were affected to the same degree (Fig. 10). Large stock of birds grown up in crowded conditions, poor light and kept out of natural resources are the most exposed to the weak development of bones that may cause rickets, the fracture of bones and other diseases of the skeletal system (Pickett 2007).

**Conclusions**

The so far studied archaeological evidence for pathological lesions in bones of domestic hen suggests that the mechanic damage of bones such fractures and necroses are the most common injuries to be found. According to the terrestrial way of life and heterogamous behaviour of males in this species, these wounds may be due to accidents and intraspecific conflicts alike. Moreover, domestic hen in Europe has lived nearby people for almost three millennia, who are involved in its breeding and care. Poor handling or insufficient treatments may have also led to various bone-injuries and metabolic disease, such as rickets.

The modest assemblage under study also offered important evidence for the display and spread of *osteopetrosis*. This contagious disease was present in the Carpathian Basin as early as the period of the Roman Empire. The incomplete skeleton found in a medieval feature indicated that the sternum and wing bones may be more affected than the leg bones. Another specimen, from a coeval site in the castle of Buda, exhibited a cerebral hernia and suggests the presence of crested hens in the medieval capital of Hungary.


Fig. 9. **Twisted sterni showing rickets**


Fig. 10. **Gnawed pair of curved tibiotarsi displaying rickets**

Facing the lack of prevalence data for different types of pathology gives rise to encourage vertebrate palaeontologists as well as archaeologists and archaeozoologists for collecting/selecting avian remains. Their future study within expanded datasets may offer further information regarding bird-bird and human-bird relations.

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