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SECONDARY HEALING OF SHOULDER JOINT REGION IN WILD BOAR (*SUS SCROFA* L.) AFTER A GUNSHOT WOUND – CASE REPORT

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ABSTRACT

A gunshot wound on the left *regio articulationis humeri*, in a female wild boar (*Sus scrofa* L.,), involving the scapula and humerus due to an inaccurate shot with a lead bullet, was described. The left and right scapula and humerus were compared to highlight the difference in the bone defects that occurred, and the corresponding changes were measured osteometrically. X-rays of the bones were also performed to detect possible projectile debris (bullets). The reported case proves that the secondary self-healing of the blind gunshot wound causes a massive bone reaction (enthesophyte), which was not the cause of the death of the animal. Subsequently the discovery of such a regenerative process may influence the organoleptic meat examination after shooting, in wild boar hunting and has an eco-toxicological meaning.

Key words: wild boar, blind *vulnus sclopetarium*, secondary healing wound, enthsophyte of scapula, lead ammunition.

Introduction

The wild boar (*Sus scrofa L. Family: Suidae, Order: Artiodactyla)* is ubiquitous and the most widespread large game in our country, with numbers reaching 40,000 per year. It is the object of mass hunting in our country (20, 21). The only even-toes species that, together with wolf, belongs to large game species, where group hunting is also allowed. The wild boar has tasty meat, which must be trichinelloscopied before consumption. In Bulgaria, the world record for wild boar 158.2 point according to CIC and the third trophy in the world ranking was shot (20). It has been hunted since ancient times in our country, as evidence of this is the discovered and identified bone material from a settlement mound near Kazanlak during the Neolithic and early Bronze Age, and the most game meat for food was acquired from it (Kovachev *et al.*, 1995a; Kovachev *et al.*, 1995b). The described above makes it a preferred game species since ancient times (Kovachev *et al.*, 1995a). Self-bone repair without treatment after fractures in dog, deer (Vasilev and Georgiev, 1985; Kovachev *et al*., 1995a) and roe deer (Udrescu and Van Neer, 2005) has been described in the literature. Recovery after a shot in one mandible in a wild boar has also been described (Georgiev *et al.*, 1997). The most preferred site of an accurate striking shot is the head, neck, heart and lung, liver and kidneys (Petrov, 2007). As in the cranially convex angle concluded between the scapula and the humerus is the best target compared to the head, neck and other regions, as here the object of impact is larger on the one hand, and on the other hand the animal does not fall suddenly and walks from 20 to 150 meters until it falls (Petrov, 2007). This explains why, topographically, the shoulder joint region is most often affected along with the head (Stamberov, 2022). Shooting in the head and neck is more accurate and instantaneous, but is not preferable because the hit animal falls almost immediately and may not be found (Petrov, 2007). On the other hand, scapula fractures are extremely rare, 0.1–0.2% in dogs and cats per 10,000 fractures, with the most frequently fractured bone in dogs being the radius and the femur in cats (7.2% respectively 6.9 % per 10000). The humerus is also quite rarely affected by fractures with 1.4% in the dog and 1.5% in the cat (Roush, 2015).

It is known that a gunshot wound, *vulnus sclopetarium* is understood to mean all tissue damage that is caused by the action of gunshot. which are bullet-shaped, ball-shaped, and fragments of shells, mines, grenades, etc. Penetrations are those in which the bullet, shrapnel or pieces of projectile pass through the body and exit, resulting in two holes - entrance and exit. Usually the entrance is with a small diameter than the exit, if the projectile (bullet, shrapnel) gets stuck somewhere in the tissues, it is described as a blind gunshot wound (23).

The presented facts led us to describe this case, which is interesting not only from the side of secondary healing that occurred in nature, but also for the development of compensatory mechanisms for survival in the environment without treatment. It would also be useful to pay attention during the game meat inspection to evaluate and analyze the quality of the harvested meat, as well as the possibility of describing relatively rare injuries in the region of the shoulder joint.

Materials and methods

It concerns an adult female wild boar (*Sus scrofa* L.,) shot on the territory of a hunting farm in the town of Trun in 2021. After processing the bone material according to standard methodology, obtained by boiling body parts and bleaching the bones in hydrogen peroxide (15%), the left and right scapula and corresponding humerus were photographed and compared. The bone defects were osteometrically measured with a caliper and a ruler. X-ray images in lateral projections of the damaged left scapula and humerus were made. An "Eickemeyer® Vet, model E 7239X" radiograph were used. Nomina Anatomica Veterinaria, 2017 (Staszyk and Conastantinescu, 2017) and Illustrated N.A.V, 2018 (Budras and Constantinescu, 2018) were used to describe the bone structures and muscles of wild boar.

Results and Discussion

By external inspection, the neck of the left scapula, *collum scapulae* was mostly affected compared to less pronounced changes in the proximal parts of the left humerus were found. The bone defect (traction osteophytes or enthesophytes) of the affected scapula is 9.3 cm in height and 8.8 cm in width, the latter measurement being almost three times wider than the neck of the right healthy scapula, which is 2.7 cm (Fig 1 A, B; Fig. 2 A, B). The long diameter of the ventral angle of the damaged scapula measured through *cavitas glenoidalis* was 8.8 cm versus the healthy one, which was 3.8 cm, while the short diameter was 3.8 versus 2.8 cm, respectively (Fig. 3 A, B). A similar bone defect from a gunshot wound was described by Georgiev et al, 1997, but with a deformity of the corpus of the mandible in a wild boar, with a 3:5 mm hole occured. The cranial edge, *margo cranialis* at the *incisura scapulae*, as well as the caudal edge, *margo caudalis*, as well as the *processus coracoideuis*, the strong *tuberculum supraglenoidale*, and the weak *tuberculum infraglenodiale* of the scapula are strongly thickened and deformed (Fig. 1 A, B; Fig. 2 A, B, Fig. 3 A, B). Laterally, we observed bone changes in the distal parts of the *spina scapulae*, *fossa supraspinata* and *fossa infraspinata*. as well as medial to the *fossa subscapularis* (Fig. 1 A, B; Fig. 2 A, B). The *pars cranialis* and *pars caudalis* of the *tuberculum majus*, *tuberculum minus*, *facies m. infraspinati*, *tuberositas teres minor* of the humerus were severely deformed with multiple openings (Fig. 1 A, B; Fig. 2 A, B, Fig. 3 A, B; Fig. 4 A, B, C). Probably the described changes of the bone structures, which are the originate respectively of the *caput longum* of *m. triceps brachii*, *m. teres minor*, *m. coraco-brachialis*, *m. biceps brachii* and *m. articularis humeri* and the insertions respectively of *m. supraspinatus*, the superficial and deep part of *m. infraspinatus*, *m. subscapularis* and *m. teres minor* serve to change the angle of attachment of the muscles and increase the coefficient of their useful action (Fig. 1 A, B; Fig. 2 A, B, Fig. 3 A, B). A similar correlation was noted by Georgiev *et al.*, 1997, but related to the masticatory musculature in the wild boar - *m. masseter* and *m. pterygoideus medialis*. The articular surfaces of the *caput humeri* and *cavitas glenoidalis* are uneven and irregular (Fig. 3 A, B), which was described in chronic arthritis in pigs by Sekiguchi and Iron as early as 1917. A bone defect on the lateral surface of the *collum humeri* with size of 1.71 cm was measured too. The last was also identified on radiographic image as a structure with a hyperdense outline and a hypodense core (Fig. 5 A, B) and could be classified as traction osteophytes or enthesophytes developing at the catch sites (the insertion) of tendons, ligaments and fascia to bones. The most common cause of their formation is local trauma, but described in humans (22; Olson and Carlson, 2017), which fully corresponds to the bone defects that occur in our case. In the traction osteophyte described at the neck of the scapula, *collum scapulae*, two lead fragments with a size of about 2 mm are observed (Fig. 4 A, B), which is in confirmation of what was described by Stamberov, 2022. The author describes that when compact bone tissue is struck by a lead munition, large-scale fragmentation and dust particles similar to the size observed by us are observed. He also points out that the topographical regions most commonly affected by lead bullets are the shoulder and hip joints and the mandible due to the presence of compact bone tissue. On the other hand the head regions and the angle between the scapula and the humerus is the most desirable site of impact when the wild boar is shot (Petrov, 2007). Compared to lead-free ammunition, lead ammunition has strong fragmentation, which depends on the morphological structure and anatomotopographical position of the target tissue (Hunt et al., 2009, Stamberov, 2022). This statement gives us reason to believe that in our case a lead ammunition was used which struck the compact bone tissue of the neck of scapula, the scattered fragments led to the formation of the large bone defect in the scapula and humerus, and from there the shoulder joint was subsequently affected and the associated musculature as described above. These significant changes in this case report occurred as a result of a gunshot wound, *vulnus sclopetarium*, which was defined as blind according to the classification of these wounds (23). The relatively rare affected of the scapula and humerus in domestic animals (Roush, 2015), as well as the eventual healing without treatment, and based on our case report, warrant the demonstration of similar large bone defects or traction osteophytes in this topographic region (22). They arise on the one hand when the gunshot wound heals and on the other when compensatory mechanisms appear when the angle of attachment of the muscles of the shoulder joint is changed, which is an adaptation of the animal to its natural environment (Georgiev *et al.*, 1997). The resulting wound was not the cause of the death of the wild boar, which was also described by Georgiev et al., 1997 for similar not killed the target shots. This resulted in the emergence of the ecotoxicological point of view, where the maximum permissible content of lead for meat is 0.1 mg/kg (Mateo et al., 2006; Pain, et al., 2010; Gosheva, 2014; Stamberov, 2022), and such involvement of the bones and muscles in our case is usually above the indicated norm. Such game meat can lead to poisoning not only of humans (Stamberov, 2022), but also when pieces are given to end consumers, like hunting dogs (Högasen et al., 2016), cheetah (North , 2015) and American alligator (Camus, 1995) as already been described.

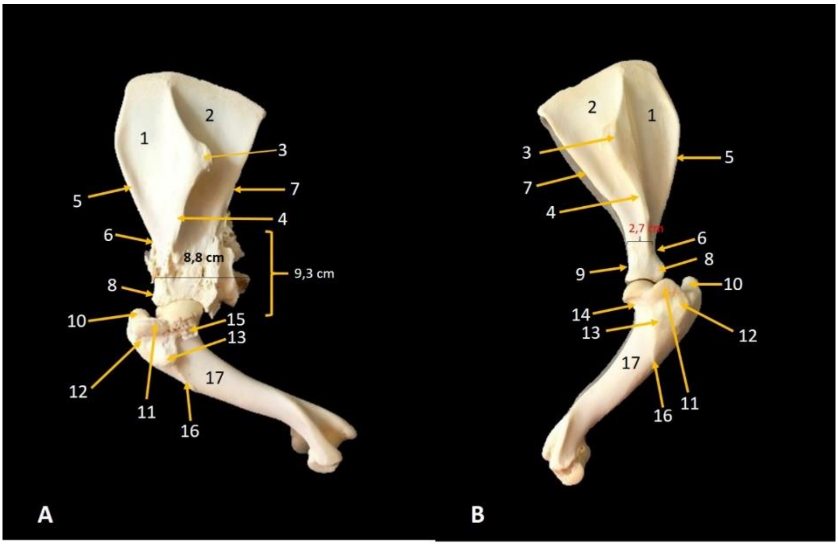

Figure 1: Affected left (A) and healthy right (B) scapula and humerus in the wild boar, lateral views. 1. *fossa supraspinata*; 2. *fossa infraspinata*; 3. *tuber spinae scapulae*; 4. *spina scapulae*; 5. *margo cranialis*; 6. *incisura scapulae*; 7. *margo caudalis*; 8. *tuberculum supraglenidale*; 9. *tuberculum infraglenoidale*; 10. *pars cranialis, tuberculum majus*; 11. *pars caudalis, tuberculum majus*; 12. *facies m. infraspinati*; 13. *tuberositas teres minor*; 14. *collum humeri*; 15. bone defect, osteophyte; 16. *tuberositas deltoidea*; 17. *corpus humeri, sulcus m. brachialis*; 9,3 cm high of traction osteophyte (enthesophyte) of *collum scapulae*; 8,8 cm width of traction osteophyte (enthesophyte) of *collum scapulae*; 2,7 cm width of healthy right *collum scapulae*.

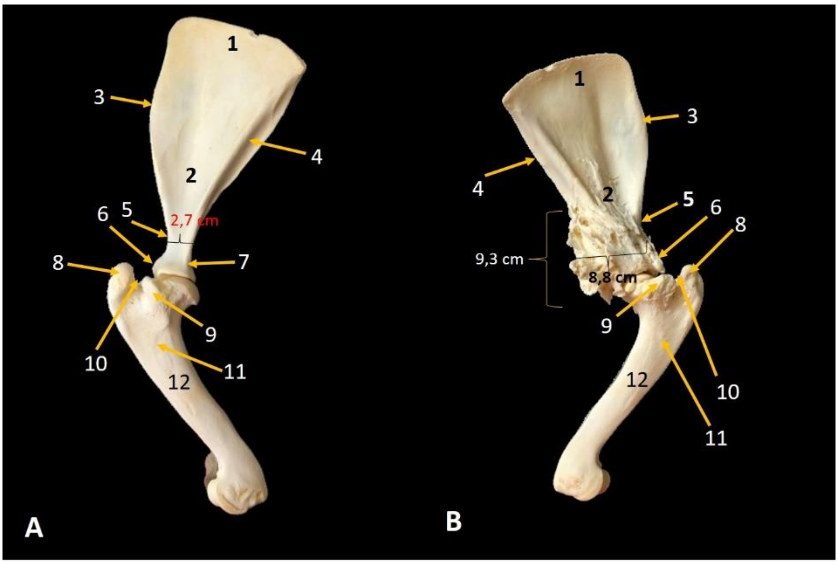

Figure 2: Healthy right (A) and affected left (B) scapula and humerus in the wild boar, medial views. 1. *facies serrata*; 2. *fossa subscapularis* 3. *margo cranialis*; 4. *incisura scapulae*; 5. *margo caudalis*; 6. *tuberculum supraglenidale*; 7. *tuberculum infraglenoidale*; 8 *pars cranialis, tuberculum majus*; 9. *tuberculum minus*; 10. *sulcus intertubercularis*; 11. *tuberositas teres major*; 12. *corpus humeri, facies medialis*; 9,3 cm high of traction osteophyte of *collum scapulae*; 8,8 cm width of traction osteophyte of *collum scapulae*; 2,7 cm width of healthy right *collum scapulae*.

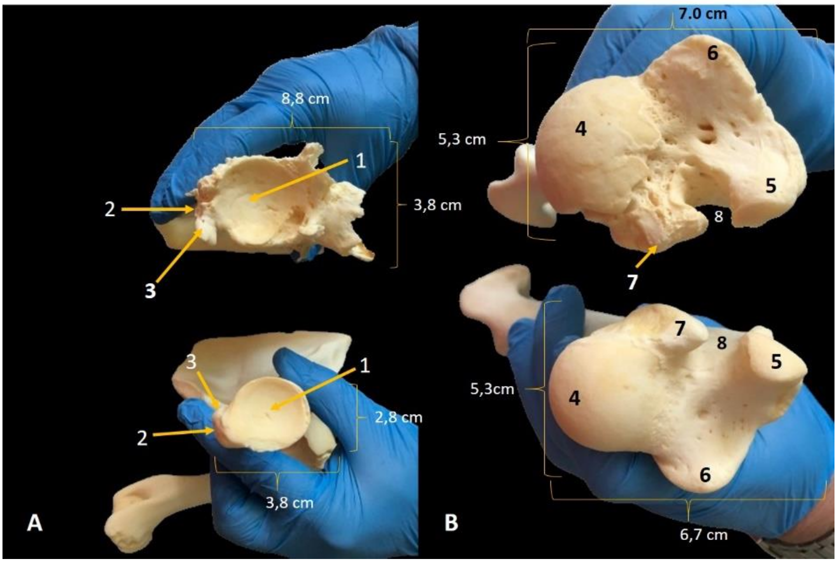

Figure 3: Ventral angle of the scapula (A) upper affected, down healthy, distal view, proximal part of the humerus (B) upper affected, down healthy in wild boar, proximal views. 1. *cavitas glenoidalis*, *facies articularis*; 2. *tuberculum supraglenoidale*; 3. *proc. coracoideus*; 4. *caput humeri*, *facies articiualris*; 5. *pars cranialis, tuberculum majus*; 6. *pars caudalis*, *tuberculum majus*; 7. *tuberculum minus*; 8. *sulcus intertubercularis*; 8,8 cm long diameter and 3,8 cm short diameter of affected ventral angle of scapula; 3,8 cm long diameter and 2,8 cm short diameter of healthy ventral angle of scapula; 7,0 cm long diameter and 5,3 cm short diameter of proximal part of the affected humerus; 6,7 cm long diameter and 5,3 cm short diameter of proximal part of the healthy humerus.

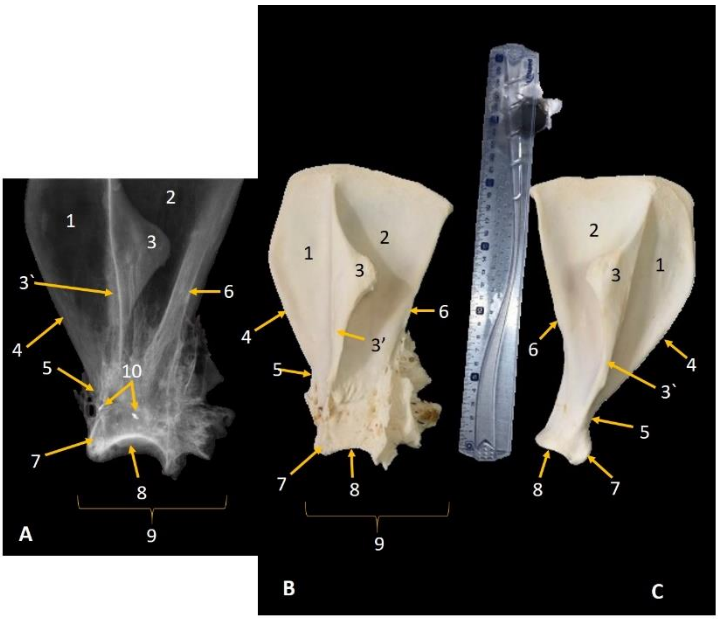

Figure 4: Radiography of affected left scapula, lateral projection (A), native view of affected left scapula, lateral view (B), native right healthy scapula, lateral view (C) in the wild boar. 1. *fossa supraspinata*; 2. *fossa infraspinata*; 3. *tuber spinae scapulae*; 3`. *spina scapulae*; 5. *margo cranialis*; 5. *incisura scapulae*; 6. *margo caudalis*; 7. *tuberculum supraglenidale*; 8. *cavitas glenoidalis*; 9. traction osteophyte (enthesophyte) in the *collum scapulae*; 10. lead scrap around of 2 mm.

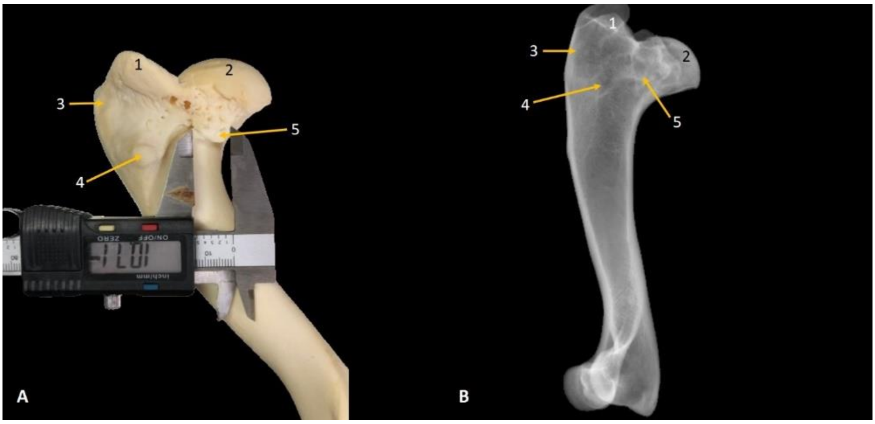

Figure 5: Affected left proximal part of the humerus, native view (A), radiography, lateral projection (B). 1. *pars caudalis, tuberculum majus*; 2. *caput humeri*; 3. *facies m. infraspinati*; 4. *tuberosits teres minor*; 5. traction osteophyte (enthesophyte).

Conclusion

The described clinical case of secondary healing due to a gunshot wound in a wild boar in the area of the shoulder joint, where traction osteophytes or enthesophytes develop, on the one hand demonstrates the emergence of adaptation mechanisms for the survival of animals in their natural environment, and on the other emphasizes the organoleptic assessment of harvested game meat in such cases, as they have an eco-toxicological significance. In a third party, he described bone regeneration occurring without treatment in the relatively rarely fractured scapula and humerus in domestic animals and gave a positive assessment of the use of lead-free versus lead ammunition used for shooting large ungulate game animals.

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