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Roman Gladiators - The Osseous Evidence.

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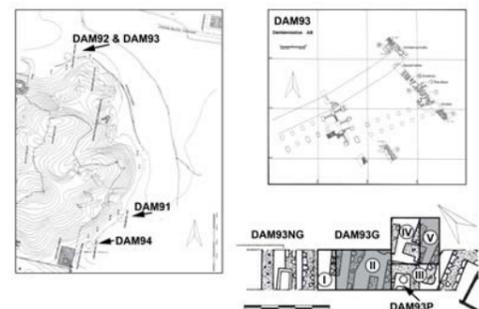
ABSTRACT
Gladiator remains of at least 67 individuals from a mass grave in ancient Ephesus (Turkey) provides the unique opportunity for proving common theories about Roman gladiators a thorough osteological and forensic examination was made.
All individuals turned out to have been males aged between 20 and 30 years, except one aged 45 to 55 years. Their mean body height was 169 cm (SD = 3 cm), quite average for the Romans at this time. Eleven (16%) individuals exhibit a total of 16 well-healed antemortem cranial trauma. Ten (15%) individuals exhibited a total of 10 perimortem cranial trauma and twenty nine (43%) acute postcranial trauma. The types and distribution of the trauma confirm the reported protective gear and weaponry and very strict nature of combat rules for gladiator fights by the absence of multiple perimortem traumatized individuals.
For example a reduced and physiotherapeutic treated fracture of a radius and a clean amputation of a tibia gives insights in the well developed medical care granted to the expensive fighters.
Enlarged muscle markers on arm and foot bones evidence an extensive and continuous exercise program.
A doubled strontium content in the gladiator's bone compared to the contemporary Roman could be detected. Explained by the reported gladiator diet of barley and beans and a administered drink consisting of plant or bone ash, which must have been served as mineral substitution. An increased frequency for acute caries might be explained by this humdrum, pulpy diet and the reduced salivation associated with frequent psychological stress.

INTRODUCTION
The first gladiator fights in Ephesus (Turkey) were held in the year 69 BC under the auspices of the Roman commander-in-chief Lucullus. Beside the great theatre the eastern part of the stadium in Ephesus, at this time the capital of the province of Asia, was converted into an elliptical Arena for the purpose of gladiatorial competitions.
A gladiator cemetery was unearthed 1993 in Ephesus, during a survey searching for the ancient course of the Holy Procession Path (Damianossita) between the Temple of Artemis (one of the seven wonders of the world) and the city of Ephesus. In situ tomb reliefs, illustrating gladiators are dating the cemetery to the turn of the 2nd and 3rd century AD [1, 2].
The cemetery is located about 300 m east of the stadium at the north foot of the Panayirdag. The whole excavation area covered only about 20 m² and delivered several thousand bones and bone fragments from the 3m thick bone-carrying layer. The distribution of the bones was of a very dislocated nature, interpreted by the archaeologists as indicating that the site had been used many times over a long time period [1, 2].
The skeletal remains from this mass grave were investigated on macroscopic, microscopic and elementary (chemical) levels, providing unique insights into cause of death and living conditions of Roman gladiators.



HISTORIC CONTEXT
Gladiators were mainly recruited from among prisoners of war, slaves and condemned offenders. There have been two different judgments by the Roman jurisdiction that forced people to fight in the arena. The ad gladium contestants (those with swords) fought in the Arena without prior training, which by rule of thumb, meant certain death. The ad ludum participants (from the gladiator school) would receive appropriate training and education, and could prove their worth in the course of the fight and ultimately achieve freedom. In addition to those mentioned above, there were hobby (volunteer) gladiators, although the possibility to die was about 1:9, at least in the 1st century AD: citizens, senators, noblemen, even emperors could all pursue training in gladiator schools.
Two referees for gladiator fights monitored very strict combat rules. Fighting was conducted by pairs recruited from seven different gladiator types (Fig. 1). The opponents carried evenly balanced attack and defence weapons, in order to ensure fairness in combat. A further consideration was the quest for matching opponents of similar strength and skill.
Since no point system existed, fighting was always pursued until a decisive outcome, which could be any of the following alternatives: defeat through death, defeat due to injury preventing further combat, defeat due to exhaustion, a win, with the bestowal of a palm branch or a laurel crown, or a draw, with both opponents being allowed to depart the Arena alive. This was the most unlikely case, since the superiority of one fighter had to be proved to enable the public to reach a verdict.
The final decision of the loser's fate resided within the hands of the games' organiser. To this end he appealed to the mood of the plebs. Upon the cry of iugula (lance him through), it was expected of the vanquished that he would set an example of the greatness of manhood (exemplum virtutis) and would motionlessly receive the death thrust. The turning down of the thumb signified to the spectators, not that the gladiator should be put to death, but rather that the gladiator was dead.

MATERIAL
Beside the human remains from the gladiator cemetery (DAM93G) several contemporary sub samples from Ephesus have been investigated for comparison. All of them have been recovered in the early 90s during the search of the Damianossita.
DAM91 = 10 female & 9 male skeletons from the East- and West garden.
DAM92 = 3 female & 3 male skeletons from the so called fig garden.
DAM93NG = 8 female & 8 male skeletons from grave houses.
DAM93P = 3 female & 13 male cremated skeletons from two pits.
DAM94 = 7 female & 8 male from several sarcophagi.



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Figure 5: Sharp trauma on the frontal bone most probably caused by a cut with a gladius. Below histological cross section of the trauma, 1st microdiagram, 2nd light microscopy and 3rd microscopic view using polarized light. Note compressed bony structure marked with arrows.

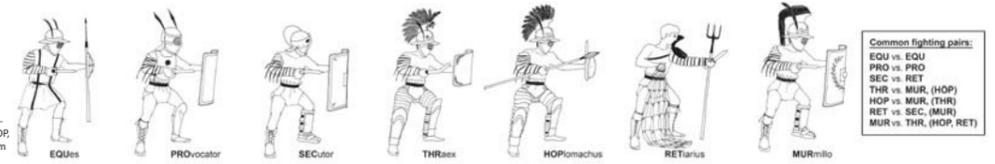


Figure 6: Typical examples for peri-, ante- and postmortal lesions found on the remains from the gladiator cemetery.



Figure 7: Sharp force trauma on frontal bone most probably caused by a trident. Below medial sagittal histological cross sections and microdiagram. Note that the inner table was not affected.

RESULTS
The Minimum Number of Individuals (MNI) Analyses [3, 4], including the most highly preserved skeletal parts (os petrosum, os occipitale, glabella, os zygomaticum, humerus, femur and dentition) revealed that at least 68 Individuals had been buried in this area of the graveyard.

Sex and age determination was done following the recommendations from Sarospaták [6] complemented by the tooth cementum annulations technique (TCA) [7]. All individuals found turned out to have been males aged between 20 and 30 years, except for one female associated with a female slave grave-stone, and one male aged 45 to 55 years [5].

The mean **body height**, calculated with the algorithm of Trotter and Gleser [8], of the male individuals was 168 cm (SD = 5 cm) and the female 159 cm. As the results from the other sub samples showed was the stature of the gladiator within the range of contemporary Romans from Ephesus (Fig. 2).

Questions relating to **trauma** were approached using techniques developed in forensic pathology and anthropology [9-13]. Data collection proceeded using methods similar to those used in modern forensic homicide cases. These include refitting, illustration, description, interpretation, and sequencing of wounds. (Fig. 3-10)

This analysis revealed single **perimortem** cranial trauma in 10 individuals (15%), and 29 acute postcranial traumata in all skeletal remains. Types and distribution of traumata confirm the reported protective gear and weaponry, as well as the very strict combat rules for gladiator fights by the absence of multiple perimortem traumata in individuals [14].

Well-healed **antemortem** cranial traumata (n=16) in 11 individuals, and altogether 16 postcranial traumata were found.

Examples of a reduced, perfectly healed radius fracture (Fig. 10), and a clean femur amputation (Fig. 9) point to a well developed **medical care** for the expensive fighters.

Enlarged muscle markers on arm and leg bones give evidence of an extensive and continuous exercise program.

Two-fold strontium content in the gladiator's bones, as compared to contemporary Ephesians could be detected by ICP-OES (Fig. 12). A likely explanation is the reported **gladiator diet** of barley and beans, plus drinking of plant or bone ash solutions, serving as extraordinary mineral substitution.

An increased frequency for **acute caries** (Fig. 11) might be explained by this humdrum, pulpy diet and the reduced salivation associated with frequent psychological stress.

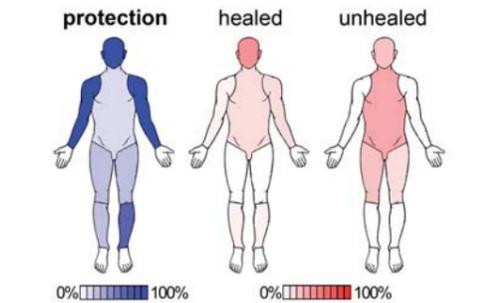


Figure 4: Left (blue): Summarization of the density of the protective gears from the seven most common gladiator types; Right (red): Summarization of the distribution densities of the identified healed respectively unhealed injuries.

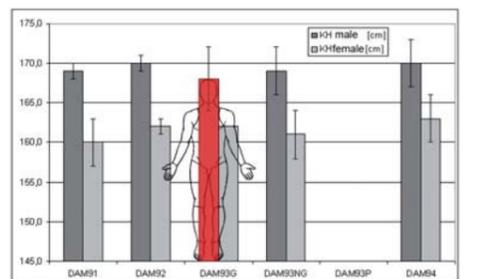
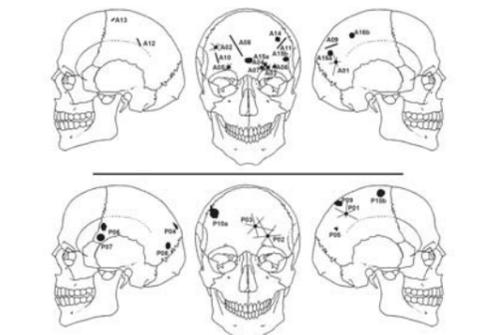


Figure 2: Mean and SD of the gladiators body height (red) and the contemporary Ephesian sub samples.

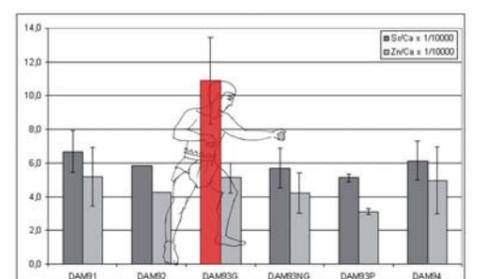


Figure 12: Mean and SD of the gladiators strontium/calcium ratio (red) and the contemporary Ephesian sub samples.

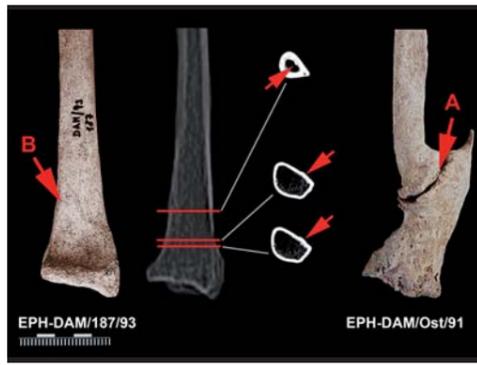


Figure 9: Perfectly healed fracture of the left distal radius from a gladiator (callus can just be seen in the CT). For comparison a untreated contemporary radius from Ephesus with a similar fracture.

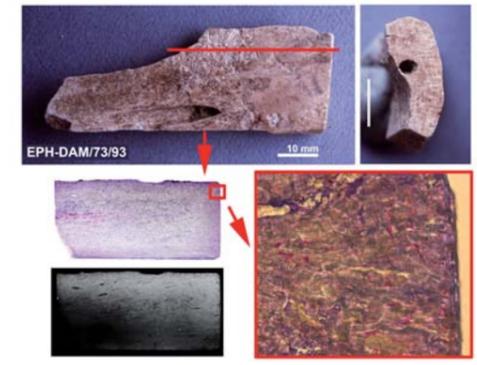


Figure 10: Bone fragment from a left femur with typical cut marks originating from an amputation. Histological cross section of the cutting edge.

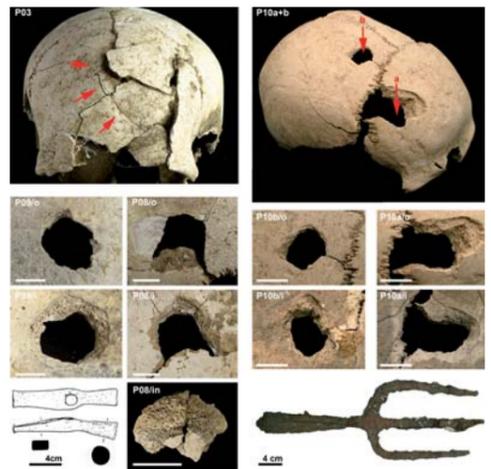


Figure 8: Typical perimortem (P) defects found on the gladiator crania; /o view on the outer table, /i view on inner table /in imprinted bone; white scale bar = 10 mm. P03 massive blunt force trauma with concentric fracture line. P08 and P09 singular punctured sharp force trauma on the parietal bone, most probably caused by a hammerhead as seen in left lower corner. P10a+b double punctured sharp force trauma on the right parietal and frontal bone, most probably caused by a trident as it could be seen in the right lower corner. Note that the distance between the two trauma is identical as between the two prongs of the trident. The ragged appearance of P10a indicates that the middle spike of the used trident was barbed.

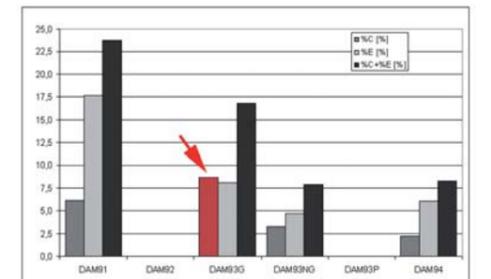


Figure 11: Caries frequencies of the gladiators and the contemporary Ephesian sub samples. C... acute caries (gladiator = red); E... intravital tooth loose

CONCLUSION
The osseous evidence found on the examined skeletons proves on one hand the historic sources and on the other hand extends our knowledge of gladiator fighting and dying technique. Ongoing and planned research on the remains from this cemetery will deepen the insights, but the brutality of this ancient spectacle still remains incomprehensible to today's socialized humans?



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