



SHORT REPORT

The Study of the Skeletal Remains of the 16th Century Italian Commander Alessandro Farnese and His Wife, Maria D'Aviz

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ABSTRACT

Enthesal changes are indicators of persistent and long-term changes induced by occupational activity and refer to marks on the skeleton where a muscle, tendon, or ligament inserts into the periosteum. Their study makes it possible to deduce further information about the person to whom the human bone remains belong. The authors present here the analysis of these markers on the bone remains of two Italian historical figures who lived in the 16th century. In 2021, the exhumation of the remains of Alessandro Farnese and Maria D'Aviz was authorized for study purposes and the skeletal remains were examined. The data collected from the examination of the mortal remains of Alessandro Farnese are compatible with historical data about his biography. As a skilled leader and assiduous sportsman, he showed signs of enthesal changes in his bone tissue attributable to physical activities. On the other hand, the case of Maria D'Aviz differs significantly from that of Alessandro Farnese in that her bone segments show no signs of enthesal changes. The analysis carried out on the remains results to be very useful in verifying the comparison with the elements present in their biography. The possibility of confirming the connection between enthesal changes and lifestyle habits is fundamental to increasing credibility in the application of these elements in the process of identifying nameless bodies in the forensic context.

1 | Introduction

The study of skeletal remains provides useful elements for reconstructing the identity of the individual to whom the remains belonged. This approach aims to reconstruct the biological profile, which includes sex, age at death, height, and populational affinities, while also being able to examine additional elements. The bones, in fact, behave like records of some activities carried out in everyday life for a sufficiently long period of time, or due

to traumatic effects, which solicit the reaction of the bone matrix (Ubelaker and Khosrowshahi 2019; Iscan and Steyn 2013; Zampetti et al. 2016).

Enthesal change markers have great informational potential as descriptors of an individual's lifestyle, as muscle stress, due to sports and/or work activity, stimulates bone support causing modest morphological changes (Cunha and Urnbelino 2014). Musculoskeletal stress markers refer to marks on the skeleton

where a muscle, tendon, or ligament inserts into the periosteum and underlying bone cortex. The term “enthesal changes” was proposed to include a wide range of causal factors, including robusticity, osteoarthritis, pressure facets, enthesopathies, and syndesmoses (ligamentous attachments), in addition to musculoskeletal stress markers (Wilczak and Kennedy 1998). From a pathophysiological point of view, when stress is regularly applied to areas where the muscle, tendon, or ligament attaches to the bone, the number of capillaries increases, stimulating the remodeling of the bone tissue (Caldarini, Zavaroni, and Benassi 2015; Hagaman 2009).

Knowledge about lifestyle habits can describe with increasing accuracy an individual whose identity is unknown. Being, therefore, useful in the forensic field in case of the need to identify nameless bodies, stress markers are the subject of in-depth studies. In the case of identification, the deductions drawn from the forensic study of the bone remains enrich the credibility of these indicators if confirmed by antemortem records (Cunha and Urnbelino 2014).

The authors report here an example of the exhumation of the skeletal remains of two Italian historical figures who lived in Italy in the 16th century.

2 | Material and Methods

On August 28, 2021, the exhumation of the remains of Alessandro Farnese and Maria D'Aviz, preserved in the Basilica of Santa Maria della Steccata (Parma, Italy), was authorized for the purpose of study and carried out (Cecchi 2022).

Alessandro Farnese was born August 27, 1545, in Rome, the son of Ottavio, prefect of the city, and Margaret of Austria, daughter of Charles V. He spent his childhood in Parma. He immediately showed great interest in the study of military art. In 1556, he accompanied Margaret of Austria to Brussels and remained at his uncle's court until the age of 20; he completed his studies in Spain. On November 11, 1565, he married Maria D'Aviz and returned with her to Parma, where he remained until 1570, when he made himself available to Don John of Austria for the campaign against the Turks. In 1577, Philip II decided to entrust Alessandro Farnese with the command of the Spanish regiments stationed in Italy that were sent to Flanders. The reconquests of the Low Countries, achieved in quick succession, document Alessandro Farnese's qualities as a condottiere. On October 2, 1578, Alessandro Farnese assumed the office of governor of the Netherlands. When his father died, he assumed the title of Duke of Parma, Piacenza, and Castro, entrusting the regency of the duchy to his eldest son Ranuccio, while in the Low Countries, he pushed the offensive further and further north. In the summer of 1589, Alessandro Farnese was commissioned to intervene in support of the French Catholics and led one of his best campaigns in France. He arrived in Arras, where he died on December 2, 1592 (Farnese n.d.).

Maria d'Aviz, also called Maria of Portugal, was the daughter of Prince Edward of Aviz, 4th Duke of Guimarães, Infante of Portugal, and son of Manuel I of Portugal and Isabella of Braganza. She married Alessandro Farnese on November 11,

1565, moving to Parma from Brussels in 1566. She had three children: Margherita, repudiated wife of Vincenzo Gonzaga and later a Benedictine nun; Ranuccio I, duke from 1592; and Odoardo, who became cardinal. He died in Parma in 1577 (D'Aviz n.d.).

The skeletal remains were examined at the Institute of Forensic Medicine in Parma. Analysis of musculoskeletal work stress markers was also performed. The skeletal remains of Alessandro Farnese were in a good level of preservation, while those of Maria D'Aviz were more fragile.

3 | Results

3.1 | Alessandro Farnese

The determination of the age of the skeletal remains of Alessandro Farnese was carried out by studying the sternal margin of the fourth rib and the auricular and pubic surfaces. The results indicated an age at death between 45 and 55 years. Biographical documentation indicates that he died at the age of 47. The determination of sex, based on the ventral arch, the morphology of the pelvis, and the subpubic angle according to Phenice's method, establishes that the bone remains conform to the typology of male sex for Alessandro Farnese. The analysis in detail of the human remains is given below.

Both clavicles show significant wear at the mesial extremity, a finding most represented on the right side (Figure 1.II). The spine shows an absence of lesions (Palmer, Hoogland, and Waters-Rist 2016).

The central arch of the second right rib has a bony callus and a bone thickening (Figure 1.I).

The right scapula has the edges of the surface that articulates with the head of the humerus slightly raised in the posterior and anterior areas, particularly in the anterior region. It is presumed to be osteoarthritis in the glenoid cavity.

The head of the right humerus has a more significant margin in the lower anterior region and a thickening of the diaphysis (Figure 1.III).

The right radius has a partially healed fracture, that is, in the healing phase, but not completely healed (Figure 1.III). The lesion affecting the radius is present in the proximal region of the radial shaft. The fractured bone appears off-axis and poorly re-assembled (Figure 1.III).

The acetabular cavity of the pelvis shows a “cam type deformity,” which occurs on both the right and left acetabulum (Roels et al. 2014).

The right ulna presents bony proliferation (hyperostosis) in the proximal third of the upper part of the diaphysis, attributable to the lesion present on the right radius (Felson 2013) (Figure 1.III).

Flattening of both femoral heads and shortening of necks are observed (Yoo et al. 2018) (Figure 1.IV).



FIGURE 1 | (I) Second right rib belonging to Alessandro Farnese; (a) thickening of the costal body caused by trauma; (II) right clavicle belonging to Alessandro Farnese; (a) wear of the upper end due to use frequent in the right limb; (III) right humerus, ulna, and radius belonging to Alessandro Farnese; (a) raised margin present on head of the humerus; (b) partially healed fracture of the radius; (c) bone proliferation affecting the ulna; (IV) right femur and left femur belonging to Alessandro Farnese; (a) variation of the normal morphology of the junction between the head and neck of the femur; (V) right and left first metatarsal of Alessandro Farnese with presumed traces of gout, manifested by the presence of bony beaks and surface erosion. [Colour figure can be viewed at wileyonlinelibrary.com]

Calcanei present slight enthesal changes in the Achilles tendon (Takahashi et al. 2017). The right and left first metatarsals show bony beaks and surface erosion (Felson 2013) (Figure 1.V).

3.2 | Maria D'Aviz

The analysis of the skeletal remains of Maria D'Aviz defined an age at death between 35 and 40 years according to the morphology of the sternal margin of the fourth rib and the pubic and auricular surfaces. These results are derived from the study of the stage of change of the pubic symphysis and the auricular surface. Historical sources state that she died at the age of 39. The determination of sex, based on the ventral arch, the morphology of the pelvis, and the subpubic angle as Phenice's method,

establishes that the bone remains conform to the typology of female sex for Maria D'Aviz. The analysis in detail of the human remains is given below.

The wear of the occipital articular facets is not homogeneous. The one on the right side seems to be more pronounced (Figure 2.I).

A detail of the left clavicle presents an accentuation of the articular facet at the point of articulation with the sternal cartilage (Ubelaker and Zarenko 2012) (Figure 2.II).

The dorsal region of the pubic symphysis shows a rough and pitted surface (Figure 2.III). Additionally, a small bony growth, called the pubic tubercle, is present in the upper region of the pubic symphysis.



FIGURE 2 | (I) Skull belonging to Maria D'Aviz; (II) left clavicle belonging to Maria D'Aviz; (a) accentuation of the articular facet of the margin sternal of the clavicle; (III) detail of the hemipelvis belonging to Maria D'Aviz; the arrows indicate roughness and pitting presence; (IV) hemipelvis belonging to Maria D'Aviz; the arrow indicates the sulci beneath the preauricular margin; (V) right and left hemipelvis belonging to Maria D'Aviz; the arrow points to the tubercle. [Colour figure can be viewed at wileyonlinelibrary.com]

At the lower extremities of the femurs on the ventral side, there is a slight bony relief (Klepinger and Heidingsfelder 1996). Three grooves are present in the bone tissue of the pelvis below the preauricular margin (Figure 2.IV).

4 | Discussion

4.1 | Alessandro Farnese

Estimating the age at death of the bone remains of Alessandro Farnese, the bone elements studied indicate an age at death also including an upper limit larger than the actual age.

With reference to musculoskeletal work stress markers, several bone elements showed relevant characteristics. Alessandro Farnese went down in history for having skilfully pursued a military career for many years. According to an occupational medicine perspective, he was therefore exposed to the traumatological risks of armed conflicts according to the weapons in use in the 16th century (cutting weapons, pointing weapons, firearms). The accident risks to which it

was subject were therefore linked to the way in which battle activities were carried out. The purpose of the use of military armor had similarities with the current use of so-called “personal protective equipment.” Conversely, the prolonged use of military armor, although it protected against the risk of injury, was likely to promote biomechanical overloading of the spine and consequently degenerative disc disease. In addition, the prolonged and repeated use of combat weapons was such as to favor the occurrence of alterations to the anatomical structures involved, as detailed below (Farnese *n.d.*; Koh and Gan 2022).

The wear found on the clavicle can be a sign of the aptitude for frequent physical activity that included the use of both arms with a preference for the right limb. The signs relating to muscle insertion and surface roughness are more marked on the right clavicle. This may be related to wear and tear due to aging (Cecchi 2022).

The callus observed in the central area of a rib is attributable to a previous trauma and fits in well with the accident risks to which Farnese was exposed.

The absence of lumbar spinal pathologies is ambiguous as the individual in question was used to a life linked to horse riding and wearing military armor. The vertebral bodies should show signs of crushing due to these conditions. The absence of such evidence could be justified by the notable muscular development due to the frequent sporting activity practiced by the leader (Ubelaker and Zarenko 2012). Physical activity protects the spine from microinjuries due to the continuous repercussions of galloping.

The thickening of the right scapula, as in the humerus, is both due to the usual practice of tennis and the use of the musket, an activity widely practiced by Alessandro. The use of this weapon involved placing the butt of the rifle in the hollow of the right shoulder, as Alessandro was right-handed, and this may have stimulated bone growth (Cunha and Urnbelino 2014).

The study of the bone evidence in the right humerus found correspondence with the activities carried out by Alessandro Farnese during his lifetime. The prolonged use of instruments involving stresses on the dominant upper limb fits well into the context of the activities carried out by Farnese according to the fighting techniques in use at the time and well described iconographically by Ridolfo Capo Ferro da Cagli in the manual called “Great Representation of the Art and Use of Fencing” (Cunha and Urnbelino 2014; Capoferro and Rapisardi 2010).

Regarding the fracture of the radius, Alessandro Farnese was treated standing in the middle of the battlefield after being wounded. This would confirm a poor assembly of the bone segments due to a rough medical intervention. Following the injury, which occurred in April, Farnese could no longer write or use his right upper limb well. He died in December of the same year, aged 47. The degree of evolution of the bone callus is compatible with the metabolism of a man of that age (Figure 1.III).

In these cases, signs of hyperostosis, that is, growth of bone mass, are noted. This is achieved by the bone as a response to a strong stimulation of the bone surface linked to a trauma such as an injury or a strong impact (Figure 1.III).

Hyperostosis of the ulna can be due to a superficial lesion of the bone caused, as in the case of the right radius, by the musket shot, as documented in the biography of Alessandro Farnese (Roels et al. 2014).

The deformation of the acetabular cavity represents a variation in the morphology of the acetabulum, due to continuous rubbing of the femoral head in the anterior region (Caldarini, Zavaroni, and Benassi 2015).

The cam deformity of both femoral heads can be traced back to a physical activity that involves hyperrotation of the femoral head in the acetabular cavity. This type of rotation implies the anomalous consumption of the thickness of the cartilage placed between the head of the femur and the acetabular cavity. This rotation and the repetition of a type of movement that involves continuous impacts between the femur and the pelvis causes the crushing of the head and the underlying femoral neck. This can be traced back to equestrian-type physical activity, compatible with the information relating to Alessandro Farnese, who often

used horseback riding both in his free time and in military activity (Yoo et al. 2018).

Habitual motor activity linked to the lower limbs causes the presence of entheses of the Achilles tendon. Historical sources state that Alessandro Farnese practiced a lot of sports, in particular running. During the study relating to the bony elements of the feet, signs of arthritis were detected, hypothetically attributable to the presence of gout (Yoo et al. 2018).

Each worker's health is an expression and function not only of occupational exposures and possible related health insults but also of the pathologies from which the individual suffers. Farnese suffered from gout, a metabolic pathology characterized by recurring attacks of arthritis caused by the deposition of uric acid crystals in the joints, and from dropsy, a pathology characterized by excess fluid in the serous cavities and subcutaneous tissue (Farnese n.d.; Koh and Gan 2022). This disorder is mainly linked to a type of diet. The eating style from which gout can derive is represented by the predominant consumption of meat, seafood, and beer (Figure 1.V).

The data collected from the examination of the mortal remains of Alessandro Farnese are compatible with what was found in historical sources and studies regarding his life and health (Peracchia et al. 2022; Armocida, Masciangelo, and Bussolati 2022; Perreard-Lopreno et al. 2013).

4.2 | Maria D'Aviz

The case of Maria D'Aviz tells a different story than that of her husband (Jurmain 2011). This difference was partly demonstrated in a comparative study of the dental paleopathologies of the two noble spouses (Peracchia et al. 2022).

Observing the lower side of the skull, the points where this bone district articulates with the first cervical vertebra show signs of a very specific postural attitude. The asymmetry of the cranial articular facets with the atlas confirms that the Princess was accustomed to bending her head to one side and maintaining this position for a long time.

The signs of childbirth found in the pelvic girdle are confirmed by the testimonies according to which Maria D'Aviz carried out four successful pregnancies (Waltenberger et al. 2021; Holt 1978; Waltenberger, Rebay-Salisbury, and Mitteroecker 2022; Harris 1974; Igarashi et al. 2020; Ubelaker and De La Paz 2012). This bone formation owes its formation to the muscular concentration due to the tension caused by the spasms of childbirth. Its presence indicates that the female individual where it is found likely completed at least one pregnancy (Waltenberger et al. 2021; Holt 1978; Waltenberger, Rebay-Salisbury, and Mitteroecker 2022; Harris 1974; Igarashi et al. 2020; Ubelaker and De La Paz 2012) (Figure 2.V).

From the wear on the left collarbone, it is possible to deduce that Maria of Portugal used her left hand much more often than his right. Furthermore, the hunting activity to which the Princess appears to have dedicated, still left traces on the bone tissue. The difference between this sign and that found on the bone tissue of

Alessandro Farnese in the same bone region highlights how the assiduity of the practice of the same activity can influence the importance of the bone finding (Ubelaker and Zarenko 2012). The bony evidence found in the wrist draws attention to another possible correlation. Mary of Portugal was an assiduous embroiderer of altar vestments. The correspondence between this activity and the evidence of enthesal changes found is notable (Karakostis et al. 2019) and could also be accentuated due to aging. Both signs could represent markers of the habit of embroidering maintaining the position of head and wrist for a long time.

The characteristics of the distal epiphysis of the femurs are reflected in the habits of Maria D'Aviz: The Princess used to pray during the day. The data recorded on the bone tissue therefore suggest a likely correlation with this type of activity that engaged the knee joints in a perpetuated daily flexion, attributable to resting the knees on the kneeler during prayer (Klepinger and Heidingsfelder 1996). Unfortunately, the lack of several bones in the feet makes it not possible to document alterations on the tarsal-phalangeal joints, which might be present due to the hyperdorsiflexion of the toes in kneeling.

4.3 | Limitations of the Study

When dealing with archaeological finds, the study of bones is inevitably linked to limitations. The reason lies in having only ancient documentation as a biographical reference. These documents are essential to confirm, as in this study, the type of activity carried out. Relying on the historical writings means accepting that they may be incomplete. It is also possible that the activities described may have been different in the past compared with their modern meaning. In this study, sporting and work activities, which influenced the morphology of some bone segments, are considered. The effect that these activities have on bones is based on studies carried out on modern individuals who carried out activities considered like the studied subject. It is possible that there is a difference between the methods of implementation. Therefore, the bone involvement could be different than that considered due to a different movement imposed by the activity itself.

4.4 | Conclusions

The analysis carried out on the remains of Alessandro Farnese and his wife, Maria D'Aviz, was able to verify the comparison with the elements present in their biography, thus substantiating the possibility of confirming the connection between enthesal changes and lifestyle habits. This is crucial to increase credibility in the application of these elements in the process of identifying nameless bodies. Further illustrative cases are necessary to increase the accuracy of the deductions made from the study of these elements.

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Disclosure

The views expressed in the submitted article are our own and not an official position of the institution.

Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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