II MEETING NAZIONALE
Gruppo Italiano di Paleopatologia

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Coevolution of Diet and Brain in Homo spp.

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The story begins in Africa 6-7 mya, and includes about 24 of known human and pre-human species, among which H.sapiens on the one hand, and chimpanzees on the other were the only survivors. From the findings in the archaeological excavations of the African savannas to the modern laboratories of biomechanical analysis, radiometric dating and molecular genetics, paleontologists are furiously redesigning the tree; or, better, the bush of the human family!

Chimps and humans with Encephalization Quotient (EQ) equal to 2.0 and 5.8, respectively, show average DNA sequence divergence of 6.5 mya and share upwards of 98.5 percent of their DNA; considering substitutions of one base pair for another, the results indicate that only about 1.2 percent of the genomes are different. Humans and chimps, which have about 22,000 genes each, have essentially the same genes, but differ for when and where the genes turned on and off. When considering duplications and rearrangements of larger sections of the genetic code as well, it was found an additional 2.7 percent difference between the two genetic blueprints.

The Rift Valley in East Africa is considered the cradle of mankind, namely the place where it has evolved and diversified our species starting from Hominini of genera Sahelanthropus (6.9 mya), Orrorin (6.0 mya), Ardipithecus (5.6-4.4 mya), Australopithecus (4.1-2.5 mya), Paranthropus (2.6-1.4 mya), to those of genus Homo, as H.abilis (2.3-1.5 mya), H.ergaster/erectus (1.8-1.0 mya) and the first H.sapiens (0.2-0.15 mya). Australopithecines with brains of 500-550 cc and EQ of 2.5-3.0, were bipedal arboreal, mostly vegetarian insulin-sensitive, lived in a warm, moist environment in which carbohydrate derived from fruit and berries was an important source of energy. Their Megadontia Quotient (MQ) was equal to 2.0-2.7, about 2-3 times that of the chimpanzee (0.9). Brain and reproductive tissues by our ancestors hominids developed strict requirements for the specific glucose as an energy source.

With the first severe glaciation, 2.5 mya, global temperatures fell dramatically and resulted in drying of moist African forest, open woodland and savannah. Hominids that were unable to use grasslands became increasingly carnivorous. The first stone tools in the fossil record coincide with the existence of H habilis (MQ=1.9; EQ=3.6), suggesting that they may have supplemented a vegetarian diet with scavenged meat. Later H.erectus (MQ=1.0; EQ=4.0) is known to be an active hunter and was the first species to make stone tools and use fire systematically. Low glucose intake associated with a low carbohydrate, high-protein carnivorous diet, in the course of at least seven glacial periods, which dominated the last two million years of human evolution, led to insulin resistance thus becoming a survival and reproductive advantage. When food energy was abundant, but dietary carbohydrate scarce, those with greater inherent insulin resistance were able to redirect glucose from maternal use to fetal metabolism, increasing birth weight and survival of offspring. Eating meat favored the evolution of primitive human teeth, brain and behavior. Hunting and gathering along with the fire have been the strategy of the genus Homo ancestral subsistence starting from about 1.8 mya with the H.erectus, a cooked meat eater, carnivorous, active preferential, and with the ultimate appearance of H.sapiens 200 kya. From Australopithecus spp. to H.erectus, and finally H.sapiens a primary metabolic organ-selective divergence took place: the resulting brain increase stole energy both from muscles and from stomach and intestines which reduced their size accordingly.

A brain increased and thus a larger skull involved in females a larger birth canal, and the anticipated birth of the fetus, whose brain was continuing its growth postpartum so as to force human groups to be less mobile, at least until a newborn was not considered surplus and then deleted, perhaps cannibalized. Regular consumption and culturally accepted human flesh is a practice that is often resorted to in human prehistory: H.antecessor 0.8 mya at Gran Dolina in Spain, H.neanderthalensis 250 kya at Saccopastore (Rome) in Italy and 100 kya at Moula-Guercy (Arèche) in France.

There have been at least 3 waves of immigration from Africa. Various samples of H.erectus spread from Africa and colonized the Eurasia, 2-0.7 mya. The second radiation by H.heiderbergensis happened 750 - 135 kya. Modern man walked on these footsteps, having also had development in Africa, about 200 kya, and then (70 kya) also migrated to Eurasia, and besides Australia (45 kya) and Beringia (25 kya), and lastly the Americas (15 kya).

In East Africa at some point between 195 and 123 kya, the size of the populations of first H.sapiens have collapsed due to climatic conditions that made our ancestors’ African homeland uninhabitable. This would have resulted in a migration to the South around 150 kya. The southern coast of Africa would have been one of the few spots where humans could survive during this climate crisis, because it harbors an abundance of shellfish and edible plants. Everyone alive today is descended from a group of people from a single region of shelter who survived this catastrophe. Excavations of a series of sites have recovered items left behind by what it may have been that progenitor population. The Blombos Cave (Southern Cape coastline, South Africa) contains deposits currently dated between 100 and 70 kya, which mostly contain engraved ochre, engraved bone ochre processing kits, marine shell beads, highly refined bone and bifacial points. So a “Big Bang” of intelligence happened along the Costa of Extreme South 70-80 kya, which was followed by a migration back to N-E and the worldwide diffusion of H sapiens.

In Europe and Levant the early modern humans (Cro-Magnons) encountered the Neandertals. Both species have co-existed for thousands of years during the harsh winters of last Ice Age in the competition for resources in steady decline and have crossed each other with the formation of hybrids, of which the males were probably sterile. This, along with inadequate technological knowledge would lead to the disappearance of Neandertal populations 30 kya. H sapiens would suffer the same fate, but survived and have become rampant, thanks to a more suitable clothing, better tools like projectile weapons, and _hyperprosocial_ behavior, i.e. genetically encoded propensity to cooperation among unrelated individuals. From 11 populations in Africa, Europe and Americas, the expansion lineages were identified and the historical demographic variations were reconstructed: major population expansions in three continents began before Neolithic time, i.e. 15-11 kya in Africa, 13 kya till now in Europe and 12-8 kya in America. All the expansions began post-LGM (last glacial maximum, 23-17 kya) as the temperature started to rise, before the advent of agriculture. But 12.9 kya it occurred the cold and dry Younger Dryas, a relatively sudden decline of 2-6 degrees Celsius that lowered the bearing capacity of the hunting and gathering and forced the progressive use of true agricultural practices to get more food per unit of territory.
although with much more time and work, and less nutritional quality.

The archaeological and radiometric data show that various forms of domestication of plants and animals arose independently in seven locations of the globe. In the so-called Fertile Crescent region eight species of plants, including barley, wheat, barley, peas, lentils, flax and olive were domesticated 10-9.7 kya. In the same area they were also domesticated four big mammals, such as goats (9 kya), sheep, oxen, pigs (8.7-8 kya).

The encephalization process, the foundation of our global success, with the advent of agriculture has led to lifestyles incompatible with several of our ancestral genes. Indeed the modern human genome is a temporal mosaic: structure and organization of the brain have evolved quite recently, 10 kya of ~400 generations, while several genes, including those related to the nutrition, have remained mostly the Paleolithic, 2 mya of ~80,000 generations. Nutritional standards of the populations of the Neolithic were generally lower than those of the Upper Paleolithic, and life expectancies were shorter, in part due to illness. The average height dropped from 178 cm to 165 cm for men and 168 cm to 155 cm for women, and so it was until the 20th century when the average human height has recovered to pre-Neolithic. With the domestication of plants and animals there was determined (i) the sharp reduction (3-2 times) of micronutrients, fibers and other co-nutrients, as well as long chain omega-3 (LC-ω-3) (ii) the occurrence of more or less heavy food intolerance, (iii) the generation of various infective diseases, inherited from oxen (measles, tuberculosis, smallpox), pigs (influenza, pertussis), ducks and chickens (flu, malaria).

The large human brain, as a final outcome of millions of years of evolutionary experiments, is presenting ~100 billion (10³⁸) neurons, ~100 billion (10³⁸) non-neurons, ~100 trillion (10³⁸) synapses, more than 105 km of interconnections, and estimated capacity of 1.25 terabytes of data storage (10¹²). All the aforementioned is based on morpho-functional units more or less full of fibers also very long, as well as on a massive vascular network, everything made with phospholipidic membranes rich in long chain polyunsaturated acids, LC-PUFA. As a result the brain is made of unsaturated fat (60% of its dry weight)! If the muscles are mainly made of protein, and then to feed it takes the amino acids, to feed the brain they are required fatty acids, such as docosahexaenoic acid (22:6ω-3), DHA, and arachidonic acid (20:4ω-6), AA, which, therefore, are ’Brain Food’! Endogenous biosynthesis of AA and DHA from vegetable precursors cis-linoleic acid (18:2ω-6), LA, and alpha-linolenic acid (18:3ω-3), ALA, is relatively low and does not keep up with the growing body of an animal to higher growth. In animals with largest size versus the smallest, in the membranes of liver cells, precursors LA and ALA derivatives increase compared to AA and DHA; the small amount of DHA that the body can produce is used in the nerve membranes of the brain and the retina so they have limited growth. Thus, for the evolution of H.sapiens, a source of pre-formed DHA and even AA would have conferred a significant advantage in the context of neural and vascular development, respectively, constituting oneself the specific and unique requirement.

Moreover, the evolution of the visual and nervous system had occurred in the early proto-ocean environment some 600 mya. The first visual systems used vitamin A as the photon sensitive molecule with DHA as the main constituent of the lipid support for the protein and photo-transduction system. These molecules would have been present in abundance, having been produced by the blue-green algae which dominated the proto-oceans for some 2.5 billion years previously. As systems evolved differentiated functions, transmission of the electrical impulse to a specialised target was carried out at junctions/synapses exploiting specialised neurotransmitting molecules. Like the photon receptor, the lipid architecture of the synaptic membrane used DHA. Therefore, the marine food chain consistently provided the necessary DHA for the origin and evolution of simple and then the advanced neural and visual systems. It also provided necessary AA for efficient vascular system development which is essential for the provision of the disproportionately high energy requirement needed by the brain. H.sapiens is unlikely to have evolved a large, complex, metabolically expensive brain in an environment which did not provide abundant dietary LC-PUFA. Conversion of 18-carbon PUFA from vegetation to AA and DHA is considered quantitatively insufficient due to a combination of high rates of PUFA oxidation for energy, inefficient and rate limited enzymatic conversion and substrate recycling. The littoral marine, as well, as inland lacustrine food chains provided evolving human populations consistently greater amounts of pre-formed LC-PUFA than the terrestrial food chain.

D.F.Horrobin (1998) proposed that at some point of human evolution specific alterations have taken place with multifactorial metabolic changes that have resulted in an expansion of the cerebral function beyond the only mass increase: mutations in certain genes <100 kya before the spread the H.sapiens from Africa. For millions of years (‘) the increased size of the brain does not have guaranteed to our initial ancestors special creativity and intelligence. The turning point must have been acquiring better neural micro connectivity. Sudden emergence of creativity, art, religion, war, began 50-100 kya, not connected with the increase of cerebral mass per se. The brain micro connectivity depended largely on the availability of phospholipids, major components of the brain itself. In the metabolism of phospholipids related enzymes and proteins play a strategic key role. The turnover of the axons and dendrites requires large amounts of LC-PUFA and amino acids, that only a rich food animal nutrition, as meat, fish, shellfish, and eggs, can provide.

Biochemical variations related to changes in the metabolism of LC-PUFA may be identified today in the families of successful creative men where it is schizophrenia. Madness, inventiveness, and leadership co-exist in the same families in all populations sapiens: incidence = 0.5-1.5% according to WHO criteria, in all races and in all continents, albeit at variable course from case to case. Therefore, changes in the biochemistry of phospholipids and LC-PUFA would be responsible for both schizophrenia and our humanity.

F.H.Previc (2009) interpreted the differences between modern humans and prehistoric in terms of increases in brain levels of dopamine, part of a general physiological adaptation caused by increased consumption of meat 2 mya in H.habilis, still pushed on in H.erectus, H.heidelbergensis, H.sapiens from diets of meat and shellfish, climatic conditions, from ecological demands and social competition. The high dopaminergic activity of the human brain may have been responsible for the evolution of the mind itself, given that dopamine is crucial to short-term memory, cognitive transfer, conceptual abstraction, and other features of an advanced intelligence. The “high-dopamine” personality is characterized by high intelligence, a sense of personal destiny, a religious/cosmic preoccupation, an obsession with achieving goals and conquests, an emotional detachment that in many cases leads to ruthlessness, and a risk-taking mentality.

In order to flush out the underlying mechanisms of human
Diversity, genetic research led by the fixity of the genome have given way to the ‘epigenome’ analysis, i.e. the study of the whole dynamic of the relations that the genome itself generates not only with the rest of the organism but with the environment. Where, when and how genes are turned ‘epigenetically’ is probably behind many of the differences between human groups. L.Carmel, D.Gokhman, S.Pääbo, and others (2014), called Lords of Paleogenetics, reconstructed, first, the ‘epigenome’ of Neandertal and Denisovan, an extinct Siberean relative of same Neandertal, versus modern H.sapiens, designing ~2000 DNA methylation maps, by harnessing the natural degradation processes of methylated and unmethylated cytosines. Differentially methylated regions (DMRs), i.e. genomic regions with different methylation statuses are regarded as possible functional regions involved in gene transcriptional regulation. Among those genetic pattern changes, many are expressed in brain development, in large part involved in neurological and psychiatric disorders. Numerous changes were also observed in the immune and cardiovascular systems, whereas the digestive system remained relatively unchanged. Additionally, there are substantial methylation changes in the HOXD cluster that may explain anatomical differences between archaic and present-day humans.

In conclusion, this is not just a matter of genes (present or absent), but which of them are turned on and which, instead, are silenced (or have never turned on). The difference in the final evolution of Man and his prodigious brain was a game of chemical switches - methylated nitrogenous bases - without changing the DNA sequence of the existing same bases. In particular, stable carbon (δ13C) and nitrogen (δ15N) isotopes measured in skeletal tissues vary according to the ecosystem where the food is acquired and can help discriminate between groups of plants eaten, as well as marine vs. terrestrial diet and position along the food web.

The isotopic investigation presented here focussed on several sites from northern and southern regions of the Italian peninsula dated to the Neolithic and the Bronze Age. The goal of our study was to explore diet across time, while directly assessing possible levels of dietary complexity. We have analysed over 500 human and 100 animal bone samples that represent, so far, the largest isotopic dataset for Italian recent prehistory.

Our isotopic record seems to reveal a generally homogeneous dietary pattern, mostly based on the consumption of C3 plant resources with a limited contribution of animal proteins to the human diet. Surprisingly, we have noticed very little variation at the transition between the Neolithic and the Bronze Age, with differences in the isotopic ranges circumscribed either geographically or chronologically, within the two phases. In particular, for the Neolithic the only significant difference in the isotopic range seems to appear at Passo di Corvo, in the Apulian Tavoliere, where high nitrogen ratios have been associated with herding practices and (possibly unintentional) mummifying effect. For the Bronze Age, the most striking evidence comes from sites in the Po Plain, were carbon values reveal the consumption of C4 plants (i.e., millets), which appears to be unprecedented for this region of Europe.

References


Diet between the Neolithic and the Bronze Age in Italy: the isotopic evidence

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The questions that archaeologists face when it comes to food production and consumptions in past societies are normally confined to timing, waves of dispersion of crops/animals and adoption vs. abandonment of food practices. However, faunal and floral assemblages in archaeological contexts are usually highly fragmented and are biased towards the preservation of larger mammalian bones, rather than smaller mammals, fish and plant remains. The development of isotopic analysis of human and animal bone collagen offers an applicable and informative approach for directly assessing past diet, while focusing both on determining chronological changes in diet at the population level (corresponding to gross economic transitions), and examining dietary variability within specific populations.

In particular, stable carbon (δ13C) and nitrogen (δ15N) isotopes measured in skeletal tissues vary according to the ecosystem where the food is acquired and can help discriminate between groups of plants eaten, as well as marine vs. terrestrial diet and position along the food web.

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References


Burials of Casal Bertone (Rome, I- III century AD): analysis of some cases of metabolic disease

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The purpose of this study is to investigate the skeletal remains of the population of Casal Bertone, located in the Eastern suburbs of Rome, regarding skeletal lesions that may be indicative of child metabolic disease. Overall the sample consists of 72 inhumed subjects. The demographic composition...
of a skeletal sample reveals a high mortality rate for infants (0-6 years-45.8%). This report considers abnormal lesions found in two infants at least. The individual T.71 (18-24 months of age) is represented by the right lower limb, ilium and ulna. Flaring and swelling of distal metaphyses, fraying bone margins growth plate, porosity growth plate, cupping deformities of growth plate metaphyses are present. The tibia and the fibula show medial bending deformities. Angulation of femoral neck and angulation of knee are visible as well. The described features lead to a likely rickets diagnosis. The specimen T.78 (6-12 months of age) exhibits bilateral porosity on the external surface of the sphenoid’s greater wing, on the endo-ectocranial surface and also on the orbital roof. Other recorded features are abnormal porosity at the palate, on the coronoid process of the mandible, around the infraorbital foramen of the maxilla and along the alveolar process, which could be associated with the bleeding gums phenomenon. Postcranial features include: slight porosity and new bone formation on the supra- and infraspinous fossae of the scapulae. Subperiosteal hemorrhages are inferred from the presence of porosity and hypertrophic new bone formation on any limb bone. The other skeletal features consist of: prominent frontal and parietal bossing, slight medial angulation of the mandibular ramus and the enlargement of costochondral rib junctions. Lastly the cortex of the distal and proximal metaphyses of the limbs is irregular and porous and the growth plates display porous frayed and flared surfaces. The metaphyses of long bones show bending and cupping. The skeleton reveals a set of lesions indicating that this individual probably suffered from rickets and scurvy.

References

Health status and isotopic variability: possible correlation in the metabolic disorders in the community of Piazza Madonna di Loreto (Rome, VII- VIII century AD)

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Paper not received

Paleonutrition of the rural Italian population from the Middle Ages to the Contemporary Age: isotopic analysis of some Tuscan skeletal samples

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The studies on paleodiet through stable isotope evidence of carbon (δ13C) and nitrogen (δ15N) content in bone collagen represent a line of investigation widely practiced in archaeology and anthropology. The application of this method in prehistoric American and European skeletal series, as well as in historical age groups, has provided new investigative tools to reconstruct environment, food economies, access to resources and social characterization of human groups in the past. This method was recently applied by the Division of Paleopathology of University of Pisa, in collaboration with the second University of Naples, in several samples from rural Tuscan cemeteries. These skeletal series are different in chronology, related to contexts of the Medieval (11th-14th century) and Post Medieval ages (19th century), from the inner Apennine and the hilly Tuscany. The comparison of sites with different settling characteristics (Parish cemeteries, graveyards of Castle), as well as within a site with individuals occupying different spatial hierarchical positions (in proximity or away from the church), provides useful data to interpret the diet as social indicator. Our analysis also offers some insights to interpret correctly the meaning of results in relation to the material characteristics of burials, settlements and of the written sources. Finally isotope models allow us to advance some hypotheses on food and diet in different human groups.

References

Dentoalveolar diseases and dietary habits in the social upper classes of the Italian Renaissance: the Guinigi family from Lucca

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Teeth and their pathologies are very important when studying
the life-style, social behaviour, health condition and diet of ancient populations. Many articles in paleoanthropological literature describe dentoalveolar diseases in the Antiquity, mainly in the low-class societies, and only a few reports regard the oral conditions of the social upper classes.

The purpose of this research is to examine the dental condition in an upper-class family of the Italian Renaissance, in terms of dietary habits and food resources. The research was carried out on the skeletal remains of the Guinigi family from Lucca (Tuscany), dated back between the end of the 14th and first half of the 17th century.

The study of dentoalveolar diseases was performed on 45 individuals and 325 teeth, equally distributed between males and females, and isotopic analysis of $^{13}C$ and $^{15}N$ was performed on 13 samples.

The frequency of dentoalveolar diseases was very high in the upper class samples, and varied from 27% to 60% of the teeth/ alveoli affected, while the frequencies were lower (16-20%) in the rural samples. Caries was extraordinary frequent in the Guinigi family with a prevalence of 70.8% in females and 43.5% in males, while ante-mortem tooth loss and abscesses were more frequent in males, whose life span was higher. Different factors may promote tooth decay, but dietary habits, as well as physiological or behavioural factors, certainly play an important role in caries development, and may explain the differences observed between sexes.

The results of isotopic analysis indicated a diet based on higher protein intake with respect to the lower social classes, with a good presence of vegetables, but gave no indication about cariogenic foods.

A large consumption of not complex sugars may be responsible, at least in part, for the high frequency of caries among the wealthy classes and in particular in the Guinigi family. It is well known that expensive and elaborate foods, including sweets, sugar cane and honey, adorned the banquet tables of Renaissance Princes. Moreover, some members of the Guinigi family, in the middle of the 16th century, founded a company for sugar cane refining and trade, probably due to the consumption of very large quantities of this elitarian food.

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Pulmonary antracosis on natural mummies of XVI-XVIII century AD from Roccapelago (MO, Italy)
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Roccapelago is a small town of the Apennines; during the restoration of the local parish church it was found a burial crypt containing the remains of 300 individuals who lived between the sixteenth and seventeenth century AD, of which at least 60 in natural mumification. Natural mumification was made possible by the unique location of the crypt built on the ruins of the ancient fortress of Roccapelago and equipped.
The tombs of the Marquises of Saluzzo in the church of San Giovanni

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The town of Saluzzo, Piedmont, in the northwest of Italy, was an important and independent marquisate from 1175 to 1548, when the France annexed its territories because the last mar- grave Gabriele died without sons. In the medieval heart of the city there is the church of San Giovanni, designated to hold the burials of the noble families and six marquises (Federico I, Federico II, Tommaso III, Ludovico I, Ludovico II and Gabriele), but the building underwent several extensions and restorations during the centuries so at present is impossible to identify the place of the medieval graves.

We performed GPR (Ground Penetrating Radar) scansion on the entire surface of the church that revealed many structural anomalies and the certain presence of some sepulchres and chamber tombs on the whole area. Then we concentrated our study on the apse where is placed the well preserved monu- mental cenotaph of Ludovico II (1438-1504), a masterpiece of ‘flamboyant gothic’, built in 1508. We lifted up the marble hatch on the ground in front of the monument and inspected the crypt, closed for at least seventy years and never photographed nor analyzed. The room was unexpectedly big (10x7 meters for 3 meters high) and accurately built. We found however a significantly altered context especially in modern times, with five lichec sarcophagi of the noble ‘Del Caretto’ family (XIX century-early XX century); in the opposite corner we noticed instead a trunk that contained scattered bones and, at least, seven skulls. We hypothesize that this ossuary was the result of a cleaning made in the crypt in modern times in order to hold new graves.

At present it is not possible to identify and date those buried, but future detailed investigations (e.g. carbon 14 and isotopes) will certainly provide more information and, perhaps, identify the marquises of the Middle Ages.

References

The mummy of Ferdinando Orsini, 5th Duke of Gravina (†1549): a paleopathological study

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In the monumental Sacristy of the Abbey of Saint Domenico Maggiore, Naples, 37 wooden sarcophagi contain the well preserved bodies of ten Aragones kings, princes and other Neapolicit nobles who died between the 15th and 16th centu-
ries. One of the arks revealed the natural mummy of Ferdinando Orsini, 5th Duke of Gravina, identified by an epigraph with his name and date of death (1549), in good condition, with the exception of the face, completely skeletonized. The skull suffers from an extensive destructive lesion that afflicted the medial wall of the orbit right, the root of the nose and, partly, the ethmoid without ostetric reaction. The histological examination performed on the bone showed wide lacunae with, inside, epithelial-like cells, partially necrotic, positive for the immunohistochemical stain for PanCK. The border between the bone and the surrounding neoplasia were clear; the brownish fleshy appearance mass had darker margins (like a palisade) and was separated from the bone by clefting artifacts.

In our opinion, the pathology that affected Orsini 500 years ago was the basal cell carcinoma in an advanced stage, in fact it is the most frequent form of skin cancer and occurs predominantly on the sun-exposed skin of adults. Microscopically the tumour tends to infiltrate the subcutaneous tissue with a peripheral palisade surrounded by loose of stroma (like a palisade) and was separated from the bone by clefting artifacts.

This case is very important because it represents one of the only four cases of malignant soft tissue tumor diagnosed in paleopathology.

References

From L’Aquila to Europe. Bodies and burials of the Franciscan Observance leading figures, 600 years after its introduction in Abruzzo region (1415)

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Due to a progressive decline of the Franciscan Order, a movement called Regular Observance took place in XIV century. An increasing number of monks left the friaries to live in poverty and hermitage. In a couple of centuries, they became the leading part of the Order. In 1415, some friars moved to L’Aquila to build the small convent of S. Giuliano, from which the Observance spread throughout Abruzzo region, as far as Italy and Europe.

The greatest exponent of the Observance, Saint Bernardino da Siena (1380-1444), visited L’Aquila twice, in order to promote reconciliation of the opposing parties. Here he died and his body was embalmed to be displayed inside a new basilica. The artificial mummy underwent at least 4 recognitions, but no detail is available about his diseases and the embalming technique adopted. Saint Giovanni da Capestrano (1386-1456) defended Bernardino from the charge of heresy, built the San Salvatore Hospital (1445-1457) and guided a Crusade against the Ottomans in eastern Europe. He died during the following epidemic. His remains are traditionally known to be destroyed by the Turks in 1526, but some Author supposed they may be still preserved and ascribed to an orthodox Saint. Saint Giacomo dellaMarca (1393-1476) also had oratorial skills and received inquisitional and diplomatic commissions in Eastern Europe from the Pope. He organized the Mount of Piety to lend money to the poor without interests. He died in Naples and his body was embalmed by the procedures used for Aragonese kings. Since 2001 his artificial mummy is preserved in Monteprandone (Marche region) and the fifth recognition held in 2008 evidenced well-developed muscular insertions, confirming the historical reports on his strong walking activity.

In the outskirts of L’Aquila are also preserved the human remains of the Blessed Bernardino da Fossa (1421-1503, skeletal remains), Vincenzo da L’Aquila (1435-1504, natural mummy) and Timoteo da Monticchio (1444-1504, skeletal remains). The mummy of the Blessed Antonia da Firenze (1401-1472) is an interesting example of female mummy and its recognition is scheduled in the near future. A systematic search for additional minor figures in Abruzzo region and a survey of their remains is in progress.

References

Paleopathological study of Mammuthus meridionalis of Madonna della Strada (L’Aquila)

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A skeleton of a male, 50-55 years old Mammuthus meridionalis, dated to the Pleistocene and conserved at the Spanish Fort in L’Aquila (Italy), showed a broken left tusk, in association with the presence of a deep (15x20 cm) bone erosion, involving the dental alveolus and the premaxillary bone, in close proximity to the maxillary sinus and the nasal cavity. During gross examination, small samples from three representative areas of the eroded bone were obtained. Thin sections were made and the specimens were examined under plane and polarized light, using a high resolution microscope with an incorporated digital camera.

Microscopic study revealed the intra vitam origin of the lesions, characterized by the presence of woven bone fibers, typical of the early phases of bone remodeling, and lamellar bone with diluted and remodeled Haversian systems. The gross and histological findings were consistent with an osteomyelitis with bone sequestration, caused by a localized blunt trauma or, more likely, resulting from an ascending,
post-traumatic chronic pulpitis, due to the tusk fracture occurred during an accident or interspecies fights. The histological exam excluded the involvement of granulomatous inflammation (e.g. tuberculosis) or neoplasia. A disease process of at least several months in duration may be hypothesized, as suggested by the histologically visible bone remodeling. A long survival of the animal after tusk loss may also be supposed, since alteration of masticatory function with altered molar teeth consumption and postural changes (i.e. atlantauxial fusion), resulting from asymmetric weight distribution, were observed.

In this study, the application of (paleo)histological techniques proved to be fundamental in order to establish the nature of bone lesions detected on archeological samples, also providing a good case for studying skull trauma and shedding light on the life history of these large mammals.

References

Application of nanoparticles in consolidation treatments of archeological bones

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Archeological bones may undergo conservation treatments to reinforce their mechanical features and save these materials from decay or to allow the completion of research analyses. Nevertheless, the materials used for the conservation may produce alterations on the original find, negatively interfering on subsequent studies, such as bone surface topography as well as on the analysis of some components of the bone tissues (such as isotopes and DNA)1. The loss of mechanical properties is often caused by demineralization processes, so that one simple and compatible way to strengthen demineralized bones could be the in situ growth of calcium carbonate, in form of aragonite crystals - having strong mechanical strength thanks to their acicular shape. The in situ growth of aragonite crystals should be obtained, in the presence of collagen as template, from the reaction of calcium hydroxide nanoparticles (nano-lime) with atmospheric CO2, thanks to high reactivity and high penetration ability of the nanostructured particles5.

Aim of the present work was to analyze the application of nanolime hydro-alcoholic suspensions on whole bones, possibly on their acicular shape. The in situ growth of aragonite crystals could be the in situ growth of calcium carbonate, in form of aragonite crystals - having strong mechanical strength thanks to their acicular shape. The in situ growth of aragonite crystals should be obtained, in the presence of collagen as template, from the reaction of calcium hydroxide nanoparticles (nano-lime) with atmospheric CO2, thanks to high reactivity and high penetration ability of the nanostructured particles5.

Aim of the present work was to analyze the application of nanolime hydro-alcoholic suspensions on whole bones, recovered from Italian medieval necropolis (XIV-XV century). Nanolime was prepared in laboratory, by a patented method, which allows to obtain pure and crystalline nanoparticles by a time- and energy-saving procedure, able to be implemented for large productions3. Before and after the nanolime treatments, bones underwent digital radiography (DR), computed tomography (CT) scanning, stereomicroscopy (SM) and scanning electron microscopy (SEM), X-ray diffraction (XRD) and DNA extraction too.

The investigations showed a penetration of the treatment inside the bones together to the filling of small pores as well as of superficial fractures, without any particular chromatic alteration. SEM images underlined the formation of a superficial thin film characterized by an acicular feature, corresponding to the aragonite growth (confirmed by XRD, showing the initial formation of aragonite crystalline phase).

Last but not at least, DNA extraction measurements put in evidence the conservation of DNA material itself after the nanolime treatments, underlying the interesting perspective of using calcium hydroxide nanoparticles in an eco-compatible consolidation of archeological bones.

References

Enlarged vascular foramina and lytic lesions in vertebral bodies: a diagnostic dilemma

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Among the skeletal material from the sites of Alghero, Mesumundu and Sant’Antico di Biscario (Sassari, Sardinia) and dated back to the period comprises between the 13th and the late 16th century 5 subadult individuals aged between 5 and 15 years and a mature male showed peculiar osteolytic phenomena of the vertebral bodies. These lesions have the appearance of enlarged vascular foramina, affecting several vertebrae mainly of the thoracic and lumbar spine, sometimes with involvement of the sacrum; on the same vertebral body several lesions are generally visible. In the literature similar features have been attributed to brucellosis or tuberculosis.

As for the Sardinian skeletal material, an imaging study on the vertebrae of the adult individual was carried out in order to evaluate the appearance of the lesions within the body. Computed Tomography evidenced internal irregular elongated cavitations, sometimes joined together; erosive rounded lesions, whose presence is not detectable externally, were also showed.
The molecular analysis has so far been performed on the subadult from Sant’Antiocho di Bicarico, but at initial analysis the DNA resulted degraded. Therefore, the nature of these lesions remains unclear, as it is not sure if they should be referred to tuberculosis, brucellosis or other pathological conditions [hemolytic anemias (e.g. Thalassemia), lymphomas, multiple myeloma and infection by Echinococcus].

Further molecular analyses will be carried out on the remains belonging to the other five individuals in an attempt to clarify the etiology of the above mentioned lesions.

References

Evidence of syphilis in a noble burial discovered in Piedmont dating back to the eighteenth century

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Ancient human remains were discovered in a burial context inside a crypt of the San Giovanni Battista church (Racconigi, Cuneo). No information is available about the origin of the buried or the dating of the bones. Historical documents suggest that the crypt dates back to when the church was built (1719-1730). The hypogeum has a roughly square shape. Access is through an opening in the ground floor of the church.

Anthropological analyses show that the bones belonged to four individuals in primary burials: three adults and one subadult. In particular, an adult (1/A) of indeterminable age was found prone and represented almost exclusively by the lower limbs; a subadult (2/A), aged 10-13 years old, was found almost completely in a supine position; an adult male (3/A), aged 58-72 years old, that was skeletal in almost all districts even though only partially preserved, was found lying on his right side; an adult male (4/A) aged 58-72 years old, almost completely preserved, was found in a supine position. Some interesting paleopathological findings were observed, in particular, lesions reflecting treponematosis. Macroscopic changes in the teeth and bones typical of venereal and congenital syphilis were detected in two adults (1/A-4/A) and in the subadult (2/A). The most characteristic cranial lesion is the pattern of scarring (caries sicca) seen on the frontal bone of adult male 4/A. Deforming osteomyelitis of the tibia and fibula were observed in adult 1/A. Hutchison’s incisors were detected in subadult 2/A.

Although paleopathology must basically describe and observe rather than diagnose and deduce on the basis of the macroscopic examination of the skeletal remains alone, it is equally true that in certain cases, like in individual or privileged burials, one can very carefully attempt to achieve a conclusive view, as in this case. Signs of an infectious disease, such as syphilis, were observed in three of the individuals that were found in the crypt of the Church in Racconigi and whom we may hypothesize were related to each other.

References

The skulls of Borgo Cerreto (Perugia): medical, surgical, and anatomical activity of Baronio Vincenzi (XVII century)

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In the Sixties of the last century the vault of a 17th century private chapel was opened, revealing three isolated skulls with evidence of surgical and anatomical activity. The chapel was built by Baronio Vincenzi, who lived and practiced medicine in Borgo Cerreto, a village in the province of Perugia, between the 16th and the 17th century. The skull bc 01 belongs to an adult male, aged 25-35 years. It shows a hole on the left front-parietal region (30 x 31 mm), that can be identified as the result of a skull trepanation. The margins of the lesion are regularly smoothed and inclined internally and the diplopic tissues result almost completely obliterated by a cicatricial bone. A bone splinter (10 x 8 mm), completely reabsorbed, can be observed on the right side of the hole. These findings are the proof of a long survival of the subject. X-ray examination confirms a regular process of ossification, without infection. Trepanation was performed with a Hippocratic trepan, largely used in cranial surgery of Modern Age. The specimen bc 02 is without skullcap and the right upper part of the face; it belongs to an adult male, 25-30 years aged. The cuts were produced by a bone saw with a thin blade. The choice of these regions suggests the willingness to study the basal skull, the right eys cavity and the paranasal sinuses. The skull bc 03 consists only in a skullcap of an adult individual, which shows the signs of a bone saw. In conclusion, the recovery of a trepanned skull, at present the first specimen of this type recovered so far in Umbria, together with two others skulls with the signs of post-mortem examination, inside the Vincenzi family vault can be probably related to the professional activity of Baronio. He was an experienced surgeon and a skilled anatomist, who certainly experienced the empirical surgery of the nearby surgical School of Preci, famous throughout Europe for the treatment of urinary bladder stones, cataract as well as the ability in skull trepanation.

References