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Cover image: embankments at the Danube waterfront of Regensburg "Donaumarkt" made of re-used Roman material, probably Carolingian (S. Codreanu-Windauer, BLfD 2014).

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beyond the theme

Pathology in the Christian medieval necropolis of "La Magdalena", Viana de Duero, Soria, Spain (c. 14th-15th)

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The necropolis of the "La Magdalena" (Soria, Spain), used from 14th to 15th centuries, contained a minimum of 26 individuals in 22 burials: 10 subadults and 16 adults (5 males, 8 females and 3 unknown). The presence of numerous pathologies was recorded: congenital diseases (*spina bifida occulta*), tumoral pathologies, infectious diseases (*brucellosis*), different traumas (fractures and dislocations), metabolic diseases (*cribra femoris*, *cribra orbitalia*, Harris' lines), osteoarthritis and local pathologies (*ostecondritis dissecans*, Schmorls' nodules). These results indicate that this is possibly a typically rural population that would likely carry out demanding physical jobs and deal with livestock.
Keywords: metabolic diseases, trauma, infectious diseases, oral pathology, tumoral pathology

La necropoli di "La Magdalena" (Soria, Spagna), in uso dal XIV al XV secolo, ospitava un minimo di 26 individui in 22 sepolture: 10 subadulti e 16 adulti (5 maschi, 8 femmine e 3 indeterminati). Si sono registrate numerose patologie: malattie congenite (spina bifida occulta*), tumori, malattie infettive* (brucellosis*), diversi traumi (fratture e dislocazioni), patologie metaboliche* (cribra femoris, cribra orbitalia, *linee di Harris), osteoartriti e patologie localizzate* (ostecondritis dissecans, *noduli di Schmorl). I risultati indicano che la popolazione sepolta è probabilmente locale, sottoposta a intense attività fisiche, anche a contatto con animali.*
Parole chiave: *malattie metaboliche e infettive, traumi, patologie orali, tumori*

1. Introduction

The material studied here was recovered by the archaeological team of *Arquetipo* during work on a canal as part of the project for the improvement and modernization of the irrigation system of the community of "Regantes del Canal de Almazán", supported by SEIASA and executed by TRAGSA.

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Twenty-two burials were dug up – twenty-one cist tombs and one simple deposition – related to the "despoblado de La Magdalena". Graves were orientated west-east (head-feet), as is usual in Christian necropolises. All the burials contain at least one inhumation in primary position. These individuals appear in supine position, with the hands crossed over the chest or placed over the pelvis, and legs stretched out and parallel.

Of these 22 burials, 18 contained the remains of one individual, 1 has a subadult-adult superposition and 3 have remains of both an adult and a subadult together.

The chronology was based on the typology of the graves, since no grave goods or coins were preserved.

2. Material and methods

The preserved bones were sent to the Universidad Autónoma de Madrid for analysis. An exhaustive and complete anthropological and paleopathological study was executed on the skeletal remains exhumed from 22 burials.

For the calculation of the degree of skeletal preservation we used the Preservation Index (PI) determined by Walker *et al.* (1988) and modified by Safont *et al.* (1999). It considers the preservation of different bone groups (IP1, IP2 and IP3) by using the equation *PI = bones preserved/bones considered x100*, where the bone groups considered are:

IP1 - Long bones (12 bones): humerus, ulna, radius, femur, tibia and fibula.

IP2 - Long bones and girdles (19 bones): IP1, scapulas, clavicles, pelvis and sacrum.

IP3 - Long bones, girdles and skull (22 items): IP2, mandible, splanchnocranium and neurocranium.

For the determination of the sex of the adult individuals we used the morphology of the pelvis (Ferembach *et al.* 1979; Bruzek 2002), cranium and jaw (Ferembach *et al.* 1980), giving advantage to pelvis results. Discriminant functions were calculated based on long bones and cranium measurements using different methods (Thieme, Schull 1957; Giles 1970; Kelley 1979; France 1983; Schulter-Ellis *et al.* 1985; Pearson, Bell 1919; McCormick *et al.* 1991; López-Buies *et al.* 1996; Trancho *et al.* 1996; Rissech, Malgosa 1997; Alemán *et al.* 1997; Safont *et al.* 2000; Albanese *et al.* 2005; Slausa, Tomicic 2005; Cañellas 2006; Kemkes, Göbel 2006). We only used these discriminant functions when

the pelvis and skull were missing. In the case of subadults, we preferred not to propose their sex considering that the secondary sexual characteristics necessary for the determination of their sex have not yet developed at these ages.

All the skeletal elements that could given age estimation were used, prioritizing the more reliable in each stage of development. In the case of subadults we followed the pattern of dental growth and development (Moorrees *et al.* 1963 modified by Smith 1991; Ubelaker 1978; AlQahtani *et al.* 2010) and the degree of ossification of the postcranial skeleton according to Scheuer and Black (2000) and Scheuer *et al.* (2004). For the determination of the age of the adults we used traditional methods: morphological changes in the pubic symphysis (Brooks, Suchey 1990), changes on the auricular surface of the ilium (Lovejoy *et al.* 1985; Buikstra, Ubelaker 1994), changes over the sternal rib end (Iscan *et al.* 1984), occlusal dental wear (Brothwell 1987) and the degree of obliteration of cranial sutures (Masset 1982). In subadults, the age was determined as accurately as possible using the aforementioned methods, while adult individuals were classified in three wider categories: young adults (16-25), middle adults (25-50) and older adults (+50).

For collecting the most important anthropological information and for the calculation of different anthropological indexes we used the program *Herrerín's Project*. For osteometric measurements classical variables were used (Olivier 1960; Krogman, Iscan 1986). Pearson (1899) and Mendonça (1998) methods were chosen for the estimation of stature, since both were developed from collections of Mediterranean populations.

Occupational stress markers are defined as changes in the structure of the bone that developed as a consequence of continuous and prolonged stress derived from habitual activities (Kennedy 1989; Stirland 1993; Capasso *et al.* 1999). According to this definition, such changes can be analyzed in order to reconstruct daily movements, positions and activities. In this population, musculoskeletal stress markers were recorded, and for their interpretation different authors were followed: Dutour 1986; Kenesi, Tallineau 1991; Casas 1997.

Morphological variations and pathological evidences have been recorded. For the pathological diagnosis a macroscopic analysis was carried out, and radiographies and CT images were taken when necessary to confirm the diagnosis.

For oral pathologies, the diseases recorded are: *dental caries*, *calculus*, *apical cysts*, *periodontitis*, *lines of enamel hypoplasia* and *antemortem tooth loss*.

Index	0 to 20	20 to 40	40 to 60	60 to 80	80 to 100	Total
IP1 (N)	4	2	5	1	**11**	23
IP2 (N)	4	4	3	4	**8**	23
IP3 (N)	5	3	2	3	**10**	23
IP1 (%)	17,39	8,70	21,74	4,35	**47,83**	100
IP2 (%)	17,39	17,39	13,04	17,39	**34,78**	100
IP3 (%)	21,74	13,04	8,70	13,04	**43,48**	100

Tab. 1. Preservation Index (PI).

3. Results

The Minimal Number of Individuals has been established as 26: 16 adults and 10 subadults. Of the adults, it was possible to estimate the sex of 13 individuals, 8 being female and 5 male.

Regarding to age estimation, we obtained the following results (percentages have been rounded to the nearest full number):

- Around 4 years: 2 individuals (8%);
- Around 5 years: 1 individual (4%);
- Between 6 and 9 years: 2 individual (8%);
- Around 9 years: 1 individual (4%);
- Young adult (16-25 years): 3 individuals (12%);
- Middle adult (25-50 years): 6 individuals (23%);
- Older adult (+50 years): 2 individuals (8%);
- 4 undetermined subadults (14%);
- 5 undetermined adults (19%).

The Preservation Index shows a majority of individuals with results between 80 and 100%, which means the skeletal remains have been preserved to a great degree. The highest results are for IP1, which indicates the long bones were better preserved than the girdles and cranium (tab. 1).

4. Stature

It was possible to estimate the stature of 10 adult individuals whose sex was determined: 6 female and 4 male. The average height according to Pearson's method (1899) is 162.9 cm for the males and 151.9 cm for the females. According to Mendonça (1998) the average height is 161.6 cm for males and 153.3 cm for females.

The stature distribution is presented in tab. 2 following the categories described by Vallois (1965).

MALES SERIES				
	Short Less than 160 cm	**Submedium** 160-165 cm	**Supermedium** 165-170 cm	**Tall** > 170 cm
Pearson	2	0	3	0
Mendonça	2	1	1	0
FEMALES SERIES				
	Short Less than 150 cm	**Submedium** 150-155 cm	**Supermedium** 155-160 cm	**Tall** > 160 cm
Pearson	4	2	1	1
Mendonça	2	2	1	1

Tab. 2. Stature distribution.

5. Occupational stress markers

Occupational stress markers were recorded in 100% of the adult specimens, in different parts of the skeleton, affecting both sexes in all the adult age groups. The main musculoskeletal stress markers detected are the following:

Hand phalanges: *Vaginae fibrosae digitorum manus*. Marker related to handling and holding instruments or tools in daily-life activities.

9 individuals (90% of individuals whose hand phalanges are preserved).

Tibia: *Squatting facet*. Lateral accessory facet at the distal epiphysis. These facets may be related to the persons frequently being in a squatting position.

8 individuals (89% of individuals whose distal epiphysis of the tibia is preserved).

Tibia: *Quadriceps femoris*. Marked insertion over the *tuberositas tibiae* related to long hikes on hard or very soft terrain, and jumping.

1 individual (8% of individuals whose proximal epiphysis of the tibia is preserved).

Os coxae: *Obturador externus and obturador internus*. Marker on the *obturator foramen*, which is in relation to the external rotation and abduction of the hip.

3 individuals (50% of individuals whose pelvis is preserved).

Radius: *Musculus biceps cubiti*. Marker over the radial tuberosity where the biceps insert, which is related to the bending of the elbow and supination of the forearm.

3 individuals (34% of individuals whose radius is preserved).

Robustness Index	MALES	FEMALES
Humerus	21,12	18,55
Radius	18,47	18,07
Ulna	14,26	15,01
Clavicle	26,31	25,08
Femur	20,95	19,46
Tibia	19,88	21,11
Fibula	12,60	14,06

Tab. 3. Robustness Index means.

Femur: *Gluteaus minimus*. Marker over the point of insertion of the muscle that works as abductor, rotator, extensor and flexor of the hip.

2 individuals (18% of individuals whose femur is preserved).

Patella: *Quadriceps femoris*. Related to walking long distances on hard or very soft terrain and jumping.

1 individual (20% of individuals whose patellas are preserved).

Calcaneus: *Tendo Achilles*. In relation to intense physical leg activity, such as walking long distances, especially on hard terrain, or lifting heavy loads.

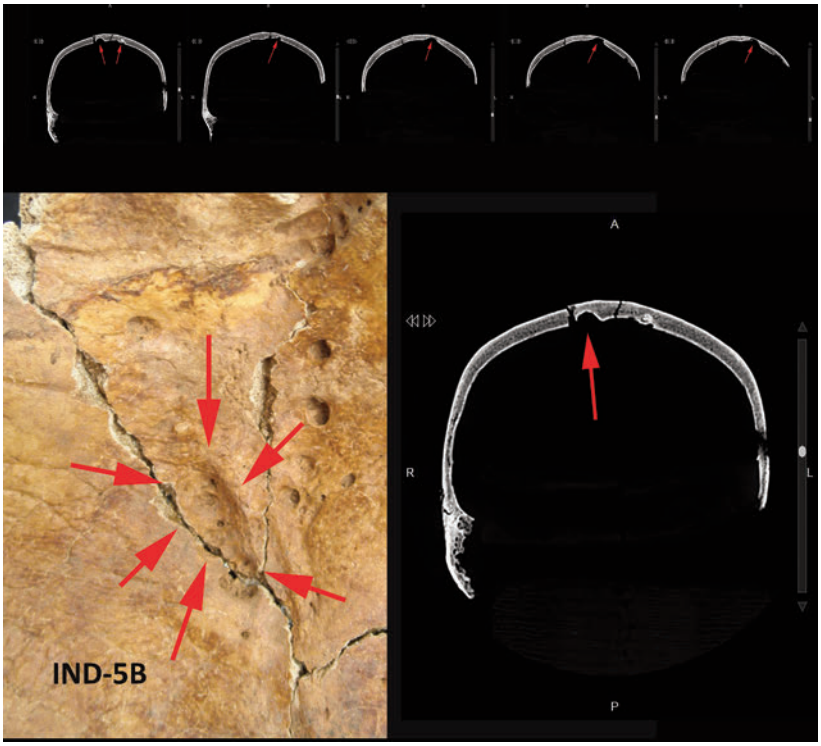
1 individual (9% of individuals whose calcaneus is preserved).

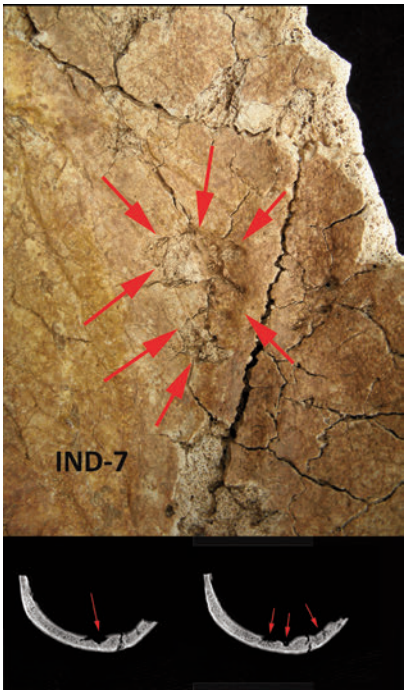
Regarding the mean of robustness index, both series (masculine and feminine) show high results for both upper and lower extremities (tab. 3).

6. Pathological study

Tumoral pathology. Two meningiomas were recorded (Ind-5B; Ind-7). A meningioma is a benign tumour that grows from the protective membranes or meninges that cover the brain (Ortner 2003; Baxarias, Herrerín 2008; Waldron 2009). It can be manifested on the bone as exostosic or osteolytic reactions in the endocranial face (Cuesta, Campillo 2007). Both cases presented here are depressions in the right parietal (figs. 2, 3). On the TAC images these cavities are clearly visible in both craniums. In relation to the individuals' affectation, the meningioma can press the brain provoking different health problems – from a headache, vertigo or weakness in a part of the body to confusion, convulsions or memory loss –, yet it does not always show symptoms.

In one of these adult individuals (Ind-5B), the meningioma appears to be associated with Pacchioni's impressions, a result of arachnoid granu-





Figs. 1-2. Meningiomas.

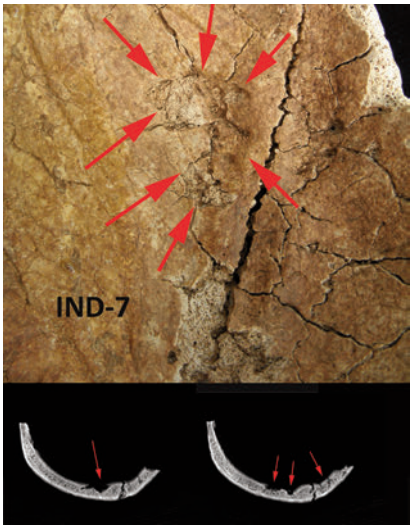


Fig. 3. *Spina bifida occulta*.

lations and a normal variant with unknown clinical significance (Baxarias, Herrerín 2008).

Congenital pathologies. A case of *spina bifida occulta* in an adult male (Ind-20) was detected. It consists of a malformation due to a failure in the formation and complete closing of the spinal lumbosacral canal (Ortner 2003; Baxarias, Herrerín 2008; Waldron 2009). This pathology is generally asymptomatic, and does not imply the neural tissue would be affected, so the individual would be able to develop into an adult. In this case, the first and second sacral vertebrae present an incomplete dehiscence of the *spinous process* while the rest of the sacrum presents a complete dehiscence with a lack of *spinous process* (fig. 1).

Trauma. Various cases were detected: bilateral elbow dislocation, fracture of two vertebral bodies in one individual and bilateral spondylolysis in lumbar vertebrae in two individuals.

A young adult female (Ind-8) presents an elbow dislocation in both arms. The articular surfaces of all the bones that form the joint (humerus, ulna and radius) appear modified, presenting a strong eburnation, which results in the formation of an anomalous joint (figs. 6-8). A deformed morphology in all the articular surfaces was observed, but the radiographs show no evidence of fracture (fig. 8). The aetiology of this double luxation is not clear. No fracture signs, symmetric conditions, the type of luxation and the shape of the articular surfaces of the bones could indicate a congenital bilateral luxation of the radius (Cockshott, Omololu 1958; Gunn, Pillay 1964; Ferrer *et al.* 1979; Mardam-Bey, Ger 1979; Kelly 1981; Miura 1990; Plasencia-Arriba, Játiva 1999).

Figs. 4-5. Elbow dislocation.

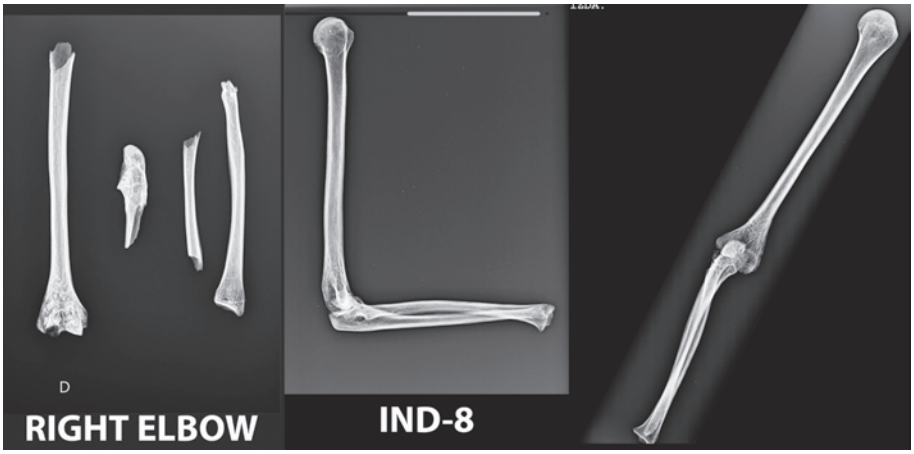
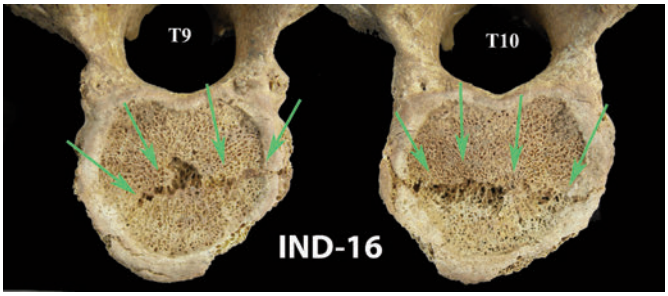


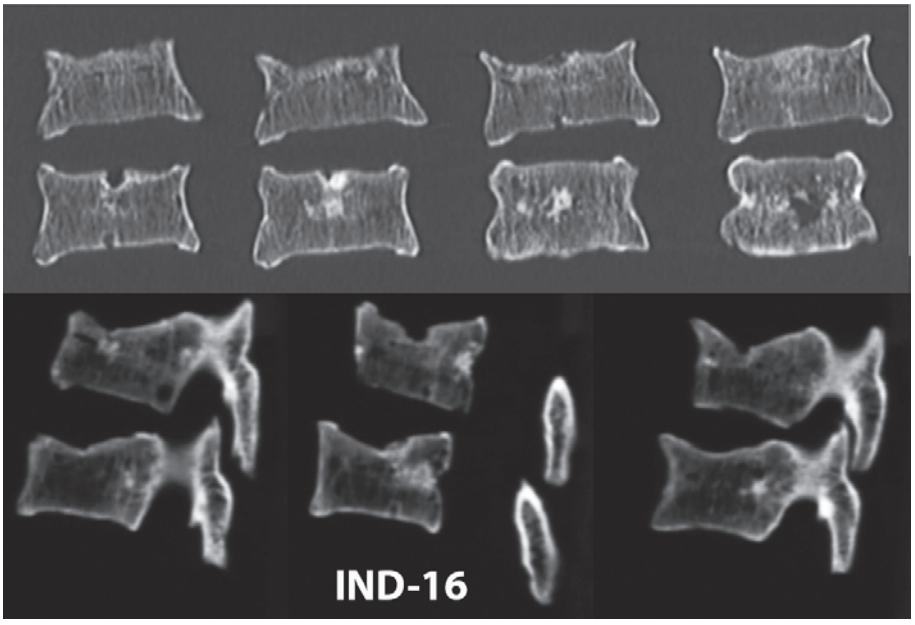
Fig. 6. Radiograph of the right elbow of Ind-8.

The triggering defect of the congenital dislocation of the radius is unknown. Hypoplasia of the humeral condyle (*capitellum*) has been proposed as the main cause of the lesion (Miura 1990; Wiley *et al.* 1991), although this defect is not present in all published cases (Almquist *et al.* 1969; Agnew, Davis 1993; Reichenbach *et al.* 1995). It is difficult to differentiate a congenital dislocation from a traumatic one that took place in the first years of life, but the hypoplasia of the humeral condyle (*capitullum*), rounded or dysplastic radius head and shortening of the ulna, are the anatomical criteria proposed by McFarland (1936) to determine a congenital aetiology. All these anatomical characteristics are present in both elbows of this individual (figs. 6- 8), but we believe, as do other authors, that they are a more adaptive phenomenon of incongruous articulation rather than the cause of the dislocation (Mardam-Bey, Ger 1979; Miura 1990).

Bilateral conditions, hypoplasia of both the *capitullum* and both radius heads, suggest a congenital origin of the pathology. The eburnation of the articular surface and the absence of joint ankylosis, suggest that the arms were used normally despite the pathology.

Some studies carried out in current clinic practice (Mardam-Bey, Ger 1979; Ferrer *et al.* 1979; Kelly 1981), indicate a variable degree of limitation of the elbow flexion in the anterior luxations, and the elbow extension in the posterior ones, as a pronosupination limitation, but in other cases this can be asymptomatic (Álvarez-García, Valverde-García 2005).

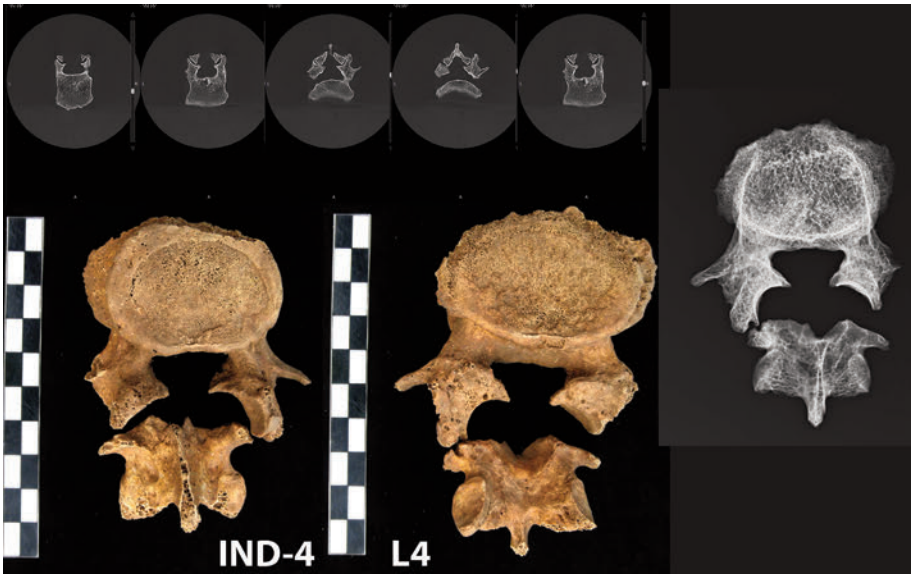


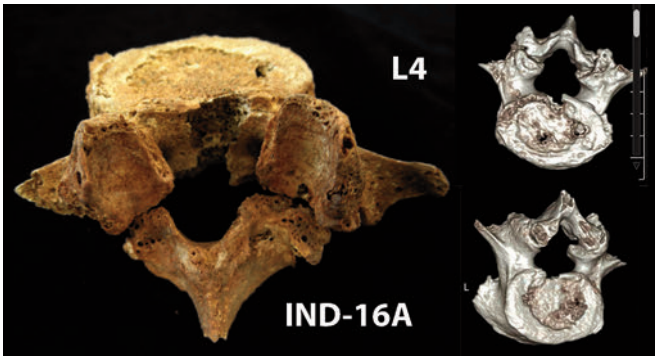


Figs. 7-8. Fractures of the vertebral body of Ind-16 (photo and CT images).

Another recorded trauma is the fracture of the vertebral body of two consecutive thoracic vertebrae (T9 and T10) on an older adult woman (Ind-16A). The fractures traverse the vertebral body from side to side, being linear and transverse to the axis, and producing a step on the surface of both bodies (fig. 9). These fractures result from indirect trauma, such as a sudden fall of the body backwards (Baxarias, Herrerín 2008), over all when the osteopenia or osteoporosis is present.

The CT images (fig. 10) show the preserved pedicles and the transverse processes without lesions. There is a subsidence of the upper platforms of both vertebrae with a bigger loss of height in the anterior wall of T9 (fig. 10). These fractures would be favoured by the presence of osteopenia or osteoporosis in the vertebrae bodies, as we observed in the CT images. They are very typical in women who have already passed





Figs. 9-10. Two cases of spondylolysis (Ind-4 and Ind-16A).

menopause, which is the case of the woman studied here. The fall would induce the crushing of the contiguous vertebrae; it would be normal for a blockage to form after the fracture and the period of healing, although it has not occurred with this individual.

Also, two cases of bilateral spondylolysis were recorded in two adult woman (Ind-4; Ind-16A; one middle aged and one older adult), both affecting the fourth lumbar vertebra (figs. 11, 12).

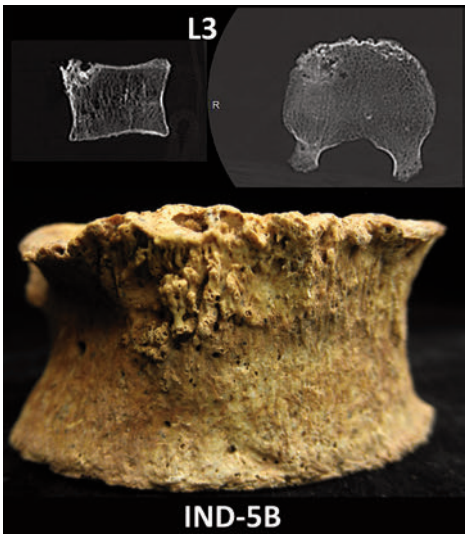
Spondylolysis is a cleft in the neural arch of a vertebra at the pars interarticularis, usually affecting the fifth lumbar (L5) (Wakely 1993; Mays 2006, 2007; Baxarias, Herrerín 2008), which causes the vertebra to be separated in two: the body and the neural arches (Ortner 2003; Baxarias, Herrerín 2008; Waldron 2009).

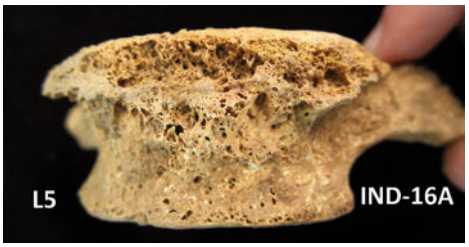
Currently the consensus about the aetiology of this pathology points to a fatigue or stress fracture as a consequence of the stresses imposed on the lower spine by locomotion (Merbs 1996; Standaert, Herring 2000; Mays 2006, 2007), rather than the diagnosis of congenital anomaly of ossification (Newell 1995).

In the case of the older adult woman (Ind-16A), the spondylolysis is associated with the compression fracture of two vertebral bodies (T9 and T10), lumbar osteoarthritis and *Schmorl's nodules*, which indicates that the individual suffered back pain, that varied in correlation with the stresses of her activities and the passing of time. Usually it is more frequent in males than females (McTimoney, Mitchell 2003), although it is present in two individual women in this case.

Infectious diseases. Two possible cases were reported.

Two adult individuals (Ind-5B; Ind-16A) have signs of *brucellosis*, a zoonosis resulting from being in contact with animals bearing the bacteria *Brucella melitensis* – cattle, goats, pigs, dogs and camels – or as a result of the consumption of dairy products from animals with this bacteria (Ortner 2003; D'Anastadio *et al.* 2011). Therefore, it is associated with cattle ranchers, a hypothesis that fits with the medieval mode of subsistence on which these individuals lived. In bone, the disease manifests as a spondilitis or destruction that is located in the anterior-superior part of the vertebral body – evidence denominated as Pedro Pons's sign – here located in a third lumbar and a fifth lumbar vertebrae. The disease can be chronic and last for years, reappearing after long periods of time. In its acute phase it manifests itself with symptoms such as abdominal or back pain, chills, sweating, fatigue, fever, headache, joint pain, loss of appetite or weakness.





Figs. 11-12. Spondilitis located in the anterior-superior part of the vertebral body, possible indicator of *brucellosis*.

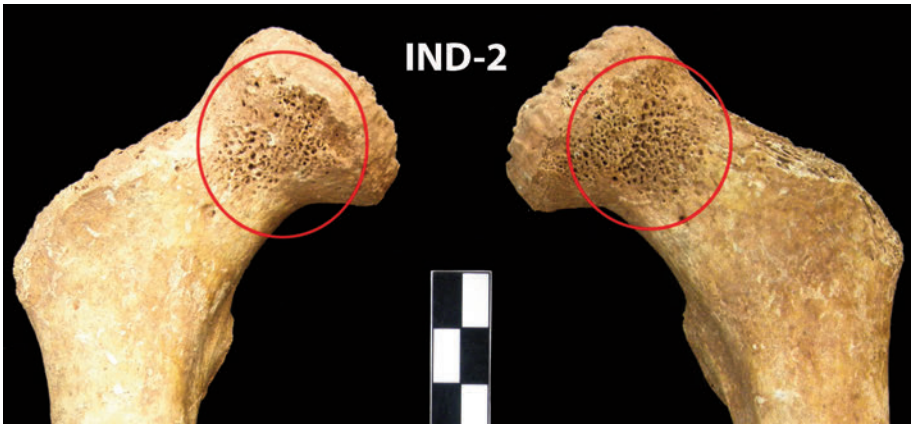


Fig. 13. *Cribra femoris* in Ind-2.

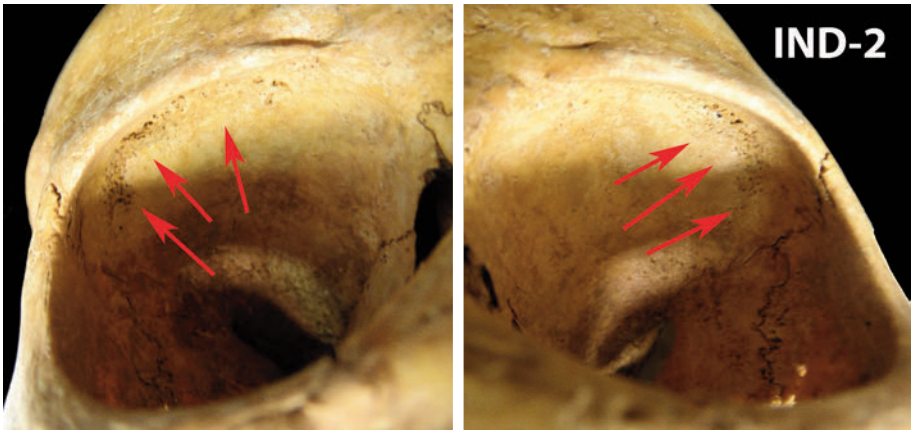


Fig. 14. *Cribra orbitalia* in Ind-2.

Metabolic diseases. Various examples were recorded: *cribra femoris*, *cribra orbitalia*, *Harris' Lines* and a possible Vitamin D deficiency.

Cribra femoris is present in 2 subadult individuals and a young adult, while *cribra orbitaria* is present in one of the subadults that have *cribra femoris* as well. Both *cribra femoris* and *cribra orbitalia* are forms of hiperostotic osteoporosis, which are manifested as tiny holes, one over the femoral neck (fig. 13) and the other over the orbital roof (fig. 14). They are asymptomatic indicators that develop during childhood, and the marks of which mark last after passing the illness. The aetiology is still unknown but it is most probable that they result from a non-specific or

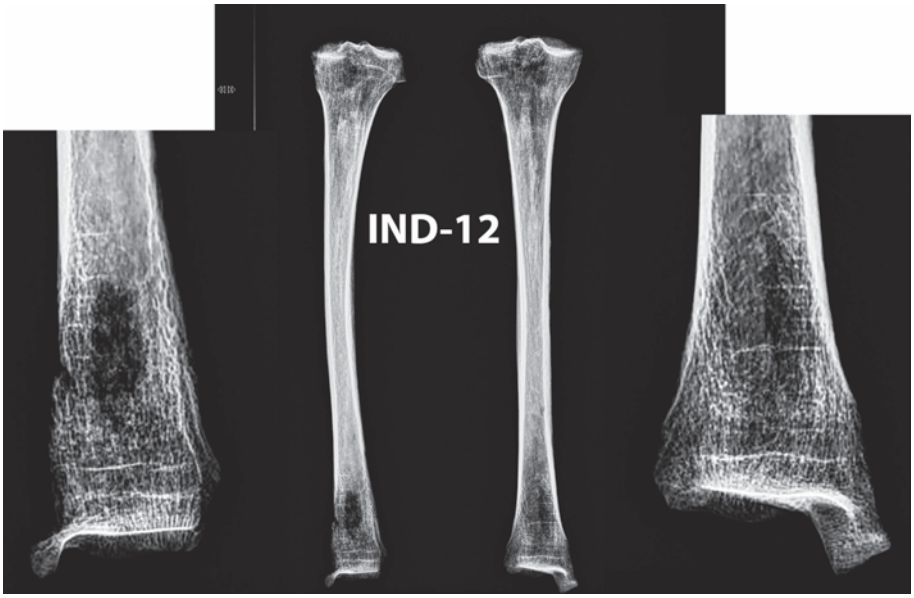


Fig. 15. *Harris' lines* in Ind-12.

chronic nutritional disease or problems with the absorption of nutrients produced by avitaminosis, diarrhea or anaemia (Nathan, Haas 1966; Hengen 1971; Grupe 1995; Wapler 1998; Miquel-Feucht *et al.* 1999; Wapler *et al.* 2004; Djuric *et al.* 2008; Walker *et al.* 2009). All cases shown here are bilateral.

Two adult individuals (Ind-12, Ind-18) show *Harris' lines* on the distal metaphysis of both tibias. *Harris' lines* are caused by bone condensation, parallel to the metaphyseal line, marking different periods of bone growth in which the bone deposition rate was slowed down or stopped, locally increasing its density (Ortner 2003; Baxarias, Herrerín 2008). Harris' lines' aetiology and correlation with other stress indicators are controversial. Although their significance is still unclear (Mays 1995), they appear to be related to non-specific stresses associated with episodes of childhood illness (Hewitt *et al.* 1955; Acheson 1959; Garn *et al.* 1968; Marshall 1968; Gindhart 1969) and nutritional deficiencies (Dreizen *et al.* 1956; Jones, Dean 1959; Platt *et al.* 1963; Blanco *et al.* 1974). Among these stresses are famines, fevers or moments of vitamin deficiency during infancy – when the bone is growing.

The lines change with age, usually disappearing over the years, so the presence of several visible lines in these adult individuals indicates that they suffered several intense episodes of stress during their childhood.

Fig. 16. *Harris' lines* in Ind-18.

In the X-ray images of the tibias of both individuals (figs. 15, 16), numerous clearly defined *Harris' lines* can be observed and in many cases they completely cross the tibial shaft.

A possible case of vitamin D deficiency or rickets in one of these two adult individuals (Ind-12) is evidenced by the curved morphology of the shaft of his tibias and the presence of *Harris' lines* (Brickley *et al.* 2010). Both signs are related to situations of nutritional stress, which this individual must have suffered during his growth period. Vitamin D is essential for maintaining the body's mineral balance. It is involved in the normal development of bones and teeth in childhood and their maintenance during adulthood, in addition to other functions, such as the normal functioning of the immune system, healthy inflammatory response, maintenance of normal muscle function, the normal absorption of calcium and phosphorus and correct cell division (Baxarias, Herrerín 2008). In the case of this individual, it is clear that the lack of vitamin D affected his bone development, but we cannot know if he was also affected by some other health problems that can induce this pathology (such as cardiovascular diseases, hypertension, autoimmune diseases or other disorders) and that leave no trace in the bones.

Evidence of **osteochondritis dissecans** (fig. 17) have been noticed in three individuals: *(1)* in one older adult male over the acetabulum of the left pelvis, *(2)* in an older female (Ind-16A) over both knee joints (on the

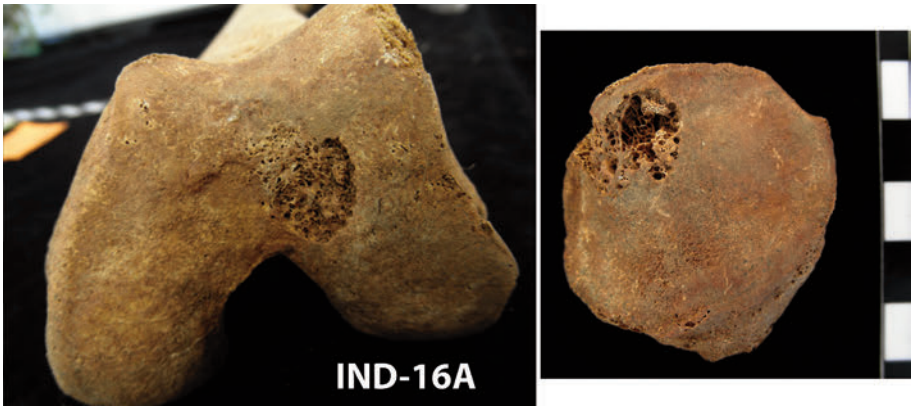


Fig. 17. Evidence of osteochondritis dissecans in Ind-16A.

medial articular facet of both patellas and on the condilar surface of both femurs) and over the head of the humerous and *(3)* in one subadult over the acetabulum of both iliums. This pathology is a type of a benign, non-inflamatory aseptic necrosis on the joint surfaces (Bradley, Dandy 1989; Schenck *et al.* 1996; Waldron 2009). Its causes still are unclear (Yadao *et al.* 2004; Baxarias, Herrerín 2008), ranging from repetitive physical trauma, ischemia or restriction of blood flow, to hereditary and endocrine factors, rapid growth, calcium and phosphorus deficiencies and imbalances, or abnormal bone formation. This pathology would have caused the individuals pain and movement restrictions.

Schmorl's nodules were documented in the case of four individuals, all adults. Schmorl's nodules appear as a result of the pressure of the intervertebral discs on the upper or lower surfaces of the vertebral bodies (Herrerín 2011). This pathology is interpreted as a reflection of mechanical stress produced by axial loads (Casas 1997), so that their presence could be directly related to the activity and posture of the individual. They also are more common in the case of older individuals, being much more frequent in the case of people over 50 years of age.

It is interesting that all age groups of adults are represented, as well as both sexes. In the case of the older women, the nodules are associated with the fracture of two vertebral bodies (T9 and T10) and a bilateral spondylolisis (tab. 4).

In the case of the young woman (Ind-19), the injury on T8 was of greater dimensions and depth than in the other vertebrae and it seems to reach the edge of the vertebral body and protrude into the medullar canal, as occurs in the case of spinal disc herniation.

IND	Sex	Age	Location	Depth and size
16A	Female	Older	C7T1, T2, T5, T6, T8, T9	Soft, not big
19	Female	Young	T8L1, L2, L3	Soft, not big
20	Male	Middle	T11, T12L1, L2, L3	Soft in all cases except L3 (deep and in both surfaces)
22	Male	Young	T10, T11L3, L4	Soft in all cases except T11

Tab. 4. Schmorl's nodules distribution (C = cervical vertebrae, T = thoracic vertebrae, L = lumbar vertebrae).

IND	Sex	Age	Location	Severity
4	Female	Middle	Lumbar (L4, L5) Tubercle of ribs Distal ephyfisis of femur	Soft lips
5B	Male	Middle	Shoulders Elbows Wrists Sternum Knees Vertebral column (thoracic, lumbar) Sacrum	Soft lips, except for an osteophyte between T12 and L1
7	-	Adult	Foot phalanges	Soft lips
9B	Female	Middle	Temporomandibular Tubercle of ribs Thoracic	Lips and porosis Soft lip Lip
15	Male	Older	1st metacarpal hand	Missouri osteoarthritis
16	Female	Older	Tubercle of ribs Lumbar (L2, L3, L4, L5)	Big lips
19	Female	Young	Lumbar (L4)	Soft lip
20	Male	Middle	C4 and T3 Distal ephyfisis of ulna	Soft lips
22	Male	Young	Lumbar (L2, L4, L5)	L2: Osteophyte L4, L5: Lips

Tab. 5. Osteoarthritis distribution.

Osteoarthritis is a degenerative disease that causes damage to the cartilage that covers the joints, causing contact between bones and the formation of a bony ridge. 60% of the adult population of this necropolis presents signs of osteoarthritis in some part of the skeleton, including both sexes in all three groups of age (tab. 5).

The main aetiology for this pathology is age, although it may also appear in young individuals due to other causes, such as genetic influences, weight or intense activity starting at a young age (Weiss, Jurmain 2007). Its symptoms are progressive and increase in time, causing discomfort and even sufficient pain to hinder movement. In the most extreme cases it can invalidate the joint (Brandt *et al.* 2003; Ortner 2003; Baxarias, Herrerín 2008).

The presence of osteoarthritis in the temporomandibular joint of a middle-aged adult, observable in both mandible condyles, is related to a modification in the bite due to the instability of the occlusal faces of a tooth (Baxarias, Herrerín 2008). In the case of this individual, this modification is a consequence of the poor state of his teeth, with dental-absence holes (upper incisors and lower left molars), the instability of the right mandible teeth and the strong wear of several dental pieces.

In the case of the young adults (Ind 19, 22, 4) the presence of lumbar osteoarthritis could be related to the vast amount of time spent in a squatting position – that other evidence confirms –, which causes the lumbar spine to maintain the balance of the trunk in a different position from the natural one (Baxarias, Herrerín 2008).

For the study of **dental pathology** we have 17 individuals with preserved teeth – 11 adults and 6 subadults. The samples add up to a total of 229 teeth – 171 adults and 58 subadult teeth.

Dental caries is a pathological process characterized by the focal demineralization and progressive destruction of dental hard tissues by the organic acids produced during the fermentation of dietary carbohydrates, especially sugars, by the dental plaque's bacteria (Baxarias, Herrerín 2008). 36% of the adults and 33% of the subadults presented this pathology (tab. 6, 7).

Calculus can be defined as the mineralized dental plaque formed by the deposit of calcium and phosphates accumulated on the dental surface, as a result of the interaction between bacterial microflora of the oral cavity and the components of the saliva (Baxarias, Herrerín 2008). 64% of the adults and 17% of the subadults presented this pathology (tab. 6, 7). It is necessary to remember that this pathology is progressive, which is the reason why normally its frequency increases with the age.

Apical cysts are described as periapical cavities in the alveolar bone. They are the result of pulp cavity infection in the apical foramen of the periapical area, which is a consequence of the exposure of the dental pulp to oral bacteria through caries, excessive dental wear and trauma (Baxarias, Herrerín 2008). 9% of the adults presented this pathology (tab. 6).

	n	t	N	T
Calculus	7	69 (15i, 11c, 16p, 27m)	64%	40%
Hypoplasia	6	26 (13i, 7c, 4p, 2m)	55%	15%
Dental caries	4	5 (1c, 1p, 3m)	36%	3%
Apical cyst	1	1 (1m)	9%	0,6%
Ante-mortem loss	5	14 (4i, 1p, 9m)	45%	-
Periodontitis	7	-	64%	-

Tab. 6. Dental pathology distribution in adults (n = individuals affected, t = teeth affected, i = incisors, c = canines, p = premolars, m = molars, N = individuals affected/individuals with preserved teeth, T = teeth affected/teeth recovered).

	n	t	N	T
Calculus	1	4 (4i)	17%	2%
Hypoplasia	2	8 (6 i, 2c)	33%	9%
Dental caries	2	5 (4m, 1ml)	33%	9%

Tab. 7. Dental pathology distribution in subadults (n = individuals affected, t = teeth affected, i = incisors, c = canines, p = premolars, m = molars, N = individuals affected/individuals with preserved teeth, T = teeth affected/teeth recovered).

Periodontitis is defined as a recession of the alveolar bone caused by pathogenic bacteria in the dental plaque (Waldron 2009). Only the horizontal periodontitis (horizontal loss in the height of the alveolar crest relative to the cement-enamel junction) was recorded. 64% of the adults presented this pathology (tab. 6).

Lines of enamel hypoplasia are defined as linear defects in the process of enamel formation indicating the existence of a period of physiological and non-specific stress during the formation of the dental crown (Baxarias, Herrerín 2008). 55% of the adults and 33% of the subadults presented this pathology (tab. 6, 7).

Ante-mortem tooth loss usually has been attributed to caries, periodontal disease, masticatory and extramasticatory behaviour, excessive dental wear, poor oral hygiene and dental trauma (Baxarias, Herrerín 2008; Hillson 2008). 45% of the adults presented this pathology (tab. 6).

On the tables showing the distribution of dental pathology in this population (tab. 6, 7) it can be seen that the most common dental pathologies among the adults are *calculus* and *periodontitis*, while for children they are *enamel hypoplasia* and *dental caries*.

7. Conclusions

The data obtained from the anthropological and paleopathological study of the remains from the medieval necropolis of La Magdalena (Viana de Duero, Soria, Spain) show the population here used to be strong and engaged in hard physical labour on a daily basis. Occupational stress markers show a population whose daily activities were related to handling instruments and tools. Also, signs of walking long distances and jumping are present in various individuals.

In addition, and related to hard work, the presence of osteoarthritis is detected in 60% of the population, including all adult age-groups and both sexes. *Schmorl's nodules* were detected in 40% of the adult individuals preserving vertebral bodies. Strong stress of the vertebral column is very clear in the majority of the individuals.

In regard to the detected pathologies, signs of different infections and accidental traumas were discovered, as well as metabolic diseases related to nutritional deficiencies. Neither signs of interpersonal violence, nor causes of death were detected among the pathologies present in this population. In the case of the subadults, signs of nutritional stresses were detected, but they could not be directly related with the cause of death of those individuals.

The dental health is compatible with the expections for a rural population in the Middle Ages (Robledo, Trancho 2007), with a high presence of *calculus*, *enamel hypoplasia* and *dental caries*, as evidence of poor oral health and hygiene in all the age groups.

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