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What can bones tell about labour and occupation:
the analysis of skeletal markers of occupational stress in the Identified Skeletal Collection of the Anthropological Museum of the University of Coimbra (preliminary results)

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Abstract. The chance to correlate the occurrence of skeletal markers of occupational stress with the lifetime occupations is very rare. The Identified Skeletal Collection of the Anthropological Museum of the University of Coimbra has a conjunction of factors that makes it ideal for this kind of research: the sample is large, the skeletons are well preserved and for each individual there is an obituary record with several identification data including occupation. Therefore, the main purpose of the present article is to find out if there is any correlation between skeletal markers of occupational stress and the occupations, testing, this way, their reliability. The preliminary results of this research are presented in this article. A series of enthesopathies (N= 31) are analised out of 151 skeletons coming from the mentioned collection. Enthesopathies are not widespread, although some of them are age-related. Our findings seem to support the statement that the role of occupational stress as a factor in enthesopathies is far from being unequivocal.

Key-words: enthesopathies; skeletal markers of occupational stress; identified skeletons.

Resumo. A análise dos marcadores de stress ocupacional constitui uma nova via de pesquisa em paleopatologia. É, no entanto, muito raro poder-se correlacionar os indicadores de stress ocupacional do esqueleto com as ocupações profissionais tidas em vida. Com a Colecção de Esqueletos Identificados do Museu Antropológico consegue-se uma conjunctura de factores extremamente favorável para este tipo de pesquisa. Para além da colecção reunir um grande número de esqueletos bem preservados, nas suas fichas de identificação constam, entre outros elementos, a actividade profissional. Assim, o objectivo principal deste artigo é averiguar a exis-

tência de correlação entre as actividades profissionais e os indicadores de stress físico. Os resultados preliminares desta pesquisa são aqui apresentados e constam da análise de 31 tipos de entesopatias em 151 esqueletos sãos e com idades compreendidas entre os 25 e os 74 anos. Não se constataram frequências elevadas de entesopatias cuja ocorrência está, em muitos casos, dependente da idade. O facto de não termos detectado relações estatisticamente significativas na ocorrência das entesopatias entre os vários grupos profissionais leva-nos a crer que o papel do stress ocupacional como factor causativo nestas lesões está longe de ser inequívoco.

Palavras chave: entesopatias; marcadores de stress ocupacional; esqueletos identificados.

Introduction

This study consists of a first approach of the skeletal markers of occupational stress analysis in the Identified Skeletal Collection of the University of Coimbra.

The mentioned Collection owns a rare and fortunate conjunction of factors that makes it, theoretically, ideal for this kind of research. Therefore the detailed composition of the series is stated on the obituary records which contain information about identity, sex, age at death and occupation, among others. Moreover, it is a large series (N=505) of well preserved skeletons. It is therefore possible to correlate the occupational stress markers with the respective individuals'occupations during life and, simultaneously, take into account pertinent and relevant factors to this kind of research such as sex and age at death. Sex, age, social status, nutritional status, lifestyle and general health profile are critical components of the genesis of a specific marker. Moreover, as it concerns a modern population (mid of 19th century to mid of the 20th) it becomes easier to go from the effect to the cause by the simple artifice of anamnesis.

Therefore, in this paper we test the accuracy of some skeletal markers of occupational stress by means of a sample examination of the mentioned Identified Skeletal Collection.

Questions such as whether the study of enthesopathies on ancient skeletons can provide additional data to the interpretation of ancient man's activities and/ or whether the use of the non-pathological skeletal markers reflecting habitual postures and muscle, can provide evidence of sexual division of labour, will be approached.

Skeletal indicators of physical stress

According to Kennedy (1989, pg.154-155) "markers of occupational stress are one expression of bone plasticity under pressure of extracorporeal and internal

forces that are not attributable to disorders of disease, metabolism, bioche- mistry, hormonal and enzymatic imbalances."

In medical and anthropological sources, around 140 markers of occupational stress are reported. As Kennedy (1989) points out, the origin of this kind of research can be find as far as the mid-sixteenth century in Europe with the medical literature of trade and military diseases. Nevertheless, only in the late nineteenth century, anatomists became aware that certain irregularities in bone could be related to life habits. According to Turner (1886 *in* Kennedy, 1989) "within certain limits the forms of the bones are without question influenced by the muscular apparatus which is attached to them".

In what the anthropological research is concerned, markers of occupational stress is an area of research of paleontologists (Trinkaus,1975), paleo-demographers (Cohen and Armelagos, 1984) as well as of forensic anthropologists (Krogman and Iscan, 1986; Iscan, 1988; Iscan and Kennedy, 1989). During the past few years, several anthropological works have proved that the study of enthesopathies in past human populations can give important information about their owners, namely about their occupations (Dutour, 1986; Owsley *et al.*, 1987; Kelley and Angel, 1987; Crubézy, 1988; Molleson, 1993; Palfi, 1992; Knusel, 1993; Lai and Lovell, 1992). Attempts have been made to reconstruct past behaviours or lifestyle aspects, such as habitual activity patterns, from archaeological remains (Edynack, 1976; Ubelaker, 1979; Molleson, 1994). Also the examination of physical effects, such as osteoarthritis, which result from changes in lifestyle (Merbs, 1983; Molleson *et al.,* 1993; Stirland, 1991).

Among the wide list of occupational markers, some of them, according to us, not very reliable as stress markers, we have chosen the enthesopathic lesions (non-articular markers), osteoarthrosis (articular markers) and Schmorl nodes. They consist of three very different categories of occupational stress markers but all of them can be, although for different reasons, related with labour and/or occupation. In this article we will solely analyse the enthesopathies (osseous lesions involving the areas of insertion of muscles or ligaments). The other two stress markers will be analised in a next article.

Enthesopathies

Enthesopathies are employed as markers of occupational stress in studies of habitual activity patterns within recent and archaeological populations (Wilczak, 1995). Bone lesions at the sites of muscles or tendons insertions on the skeleton, or entesopathies, are well known in sporting and occupational medicine to be associated with prolonged hyperactivity of the relevant muscles. Other enthesopathies are quite specifically associated with over-use of different sets of muscles.

The term enthesitis, from the greek enthesis meaning insertion, was created by the italian reumatologist La Cava (1959) to define a series of inflammatory lesions which affect the enthese, i.e., the insertion area of tendons and muscles at the level of skeleton bones. The sites of occurrence of this condition in the body are as various as the different repetition muscular actions called for different occupations as well as recreations (La Cava, 1959).

According to Zammit (1986) this neologism has the purpose to emphasize, under an anatomical perspective, the lesions qualified till that day as diseases of insertions, i.e., affections concerning the tendons without focusing the precise location of the situation.

Two aspects must be taken into account when leading with enthesopathies, formerly, that this type of affections are more common in certain bones and, secondly, they are, in some cases, associated with well defined reumatological entities.

A physical activity, occupational or sporting, when it is specialised, implies the repetition of a certain number of technical gestures. This stereotyped and mainly repetitive character, is responsible for the hyper-solicitation and for the biomechanical constraints which create microtraumatisms. These microtraumas are responsible for the microlesions in the locomotor system at several levels. These microlesions, and the consequent inflammatory or adaptive phenomena, form the constraint markers (Dutour, 1993).

Material and methods

The Sample

From the total of 505 skeletons comprising the mentioned collection, in a first stage, 26.5% (n=134) were excluded because they were too young (under 25 y.o) or too old (over 75 y.o.) for our purposes. Immature individuals, as well as very young adults would not be expected to have experienced a sufficiently long overuse of specific muscles for bony lesions to have formed. Age is indeed a factor of exclusion when the reconstruction of activities from skeletal markers is tried: degenerative changes in older individuals are not related with their activities (Dutour, 1992).

In a second phase, all the individuals included in the pretended age range (from 25 to 74 years old) which were 371, were analised in order to look for pathologies to which enthesopathies are clearly associated. We are referring to pathologies such as hyperostotic disease (DISH), spondylo-arthropathies, ankylosing spondylitis, Crohn disease, Fiessenger and Leroy Reiter syndromes (*in* Crubézy, 1988). The exclusion was applied to obvious and declared

pathological cases as well to eventual owners of these pathologies. Specifically, for DISH, skeletons with possible or probable DISH (Utsinger, 1992; Crubézy, 1990) were not taken into account for the study of enthesopathies. In this phase, in all, 15.5% of the individuals (n=78) were excluded. The majority of the cases concern individuals with DISH and ankylosis spondylites, pathologies where the occurrence of enthesopathies, usually, exuberant enthesopathies, is well proven (*in* Ibanez, 1990). A few cases where there was osseous destruction provoked by pathology (such as tuberculosis) weren't included either and are integrated in this 15.5%.

A minor percentage (1.8%) were not included because either they were incomplete skeletons (e.g. without vertebral column) or in their records there was no reference to occupation.

In all, the sample used in this analysis consists of 151 individuals, which corresponds to 53.2% of the total number of individuals available for this kind of research in the present Collection. These 76 males and 75 females, with ages at death varying from 25 to 74 years old, were all born in Portugal between 1837 and 1902 and died between 1910 and 1934.

From the individuals' age at death, five age classes (ten-year periods) were created. The individuals' distribution by each age-group, according to sex, can be seen in the following figure.

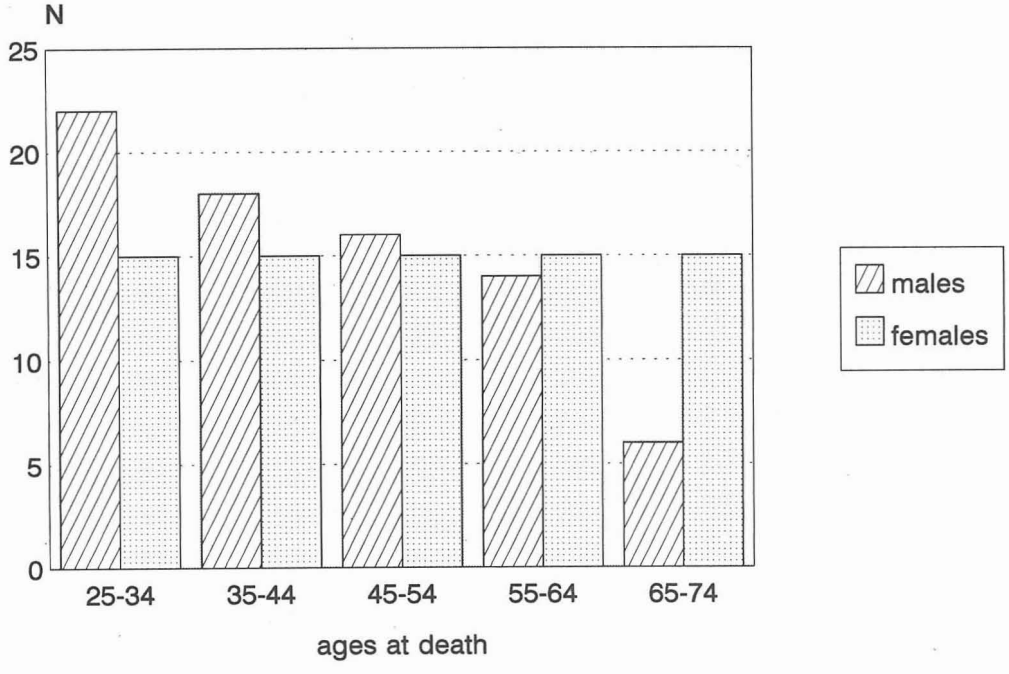

Fig. 1. Age distribution by sexes.

We have tried to obtain balanced age categories, with about the same number of individuals in each, in order to reduce eventual effects of age group size on the evaluation of age influence.

Aiming to group the several occupations, a wide variety concerning, mainly, jobs of low socio-economic profile, in narrower categories, we started by following the classification proposed by Bocquet and Morais (1987), making, in a second phase, several modifications in order to fit the categories according to the purposes of the present work. Therefore the following five categories of occupations were created:

group 1 -	rural workers and artisans whose occupations implied a strong physical effort such as the skilled work of metal worker, carpenter, carrier.
group 2 -	military and/or paramilitary.
group 3 -	industrial workers (such as railway employee), non-industrial but qualified workers (photographer; painter) and landowners.
group 4 -	housekeepers.
group 5 -	various menial jobs including home servants, sewing women and tailors.

Whereas women, in their majority (82.7%) were housekeepers (belonging the others to group 5 -14.7% and group 1-2.7%), men presented the following distribution by occupational categories (fig. 2).

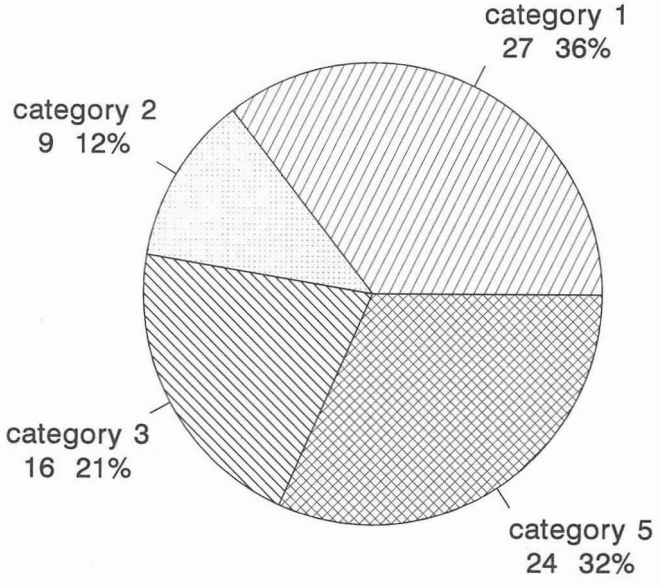

Fig. 2. Men's occupations.

In all, sexes combined, 41.1% (62/151) of individuals were occupied in domestic service (group 4); 23.8% (36/151) had various menial jobs (group 5); 18.5% (28/151) were rural workers or artisans (group 1); 10.6% (16/151) were industrial or non-industrial workers (group 3) and finally, only 9% (6/151) were military or paramilitary (group 2).

It has to be emphasized that the work of an housekeeper by the end of the 19th century and the beginning of the present one, implied a certain physical effort. Besides all the work related with the house, such as cleaning, ironing, cooking and so on, it is very probable that these women also did some outdoors work, namely in their backyards, where they probably did some small plantations. The occupations were in accordance with the socioeconomic level of the Collection.

The enthesopathies analised

The choice of the enthesopathic lesions was based, mainly, on the literature. Although we were aware that certain type of lesions were much more frequent or even more important, we wanted to test the largest number possible. Moreover, previous work with the collections (Cunha, 1994) didn't find significative bony lesions for a smaller sample.

If we count laminal spur as two different enthesopathies, considering thoracic and lombar, we analysed and classified 31 different sites for enthesopathies.

The enthesopathies analised can be seen in table 1.

Laminal spur was not searched on cervical vertebrae. Previous research (Cunha, 1992) proved that this type of enthesopathy is indeed very rare on that part of the column.

Enthesopathies were evaluated by naked-eye examination of the bones for rough patches, irregularities, or osteophytes.

The classification of enthesopathies were made according to the system proposed by Crubézy (1988), with slight modifications:

grade 0 -	if the part of the bone where the lesion was to be located was absent (missing value).
grade 1 -	if the bone is complete but without lesion.
grade 2 -	if the enthesopathy existed but in a slight mode, in other words, minimum lesion.
grade 3 -	if the enthesopathy could be easily distinguished, i.e., clear enthesis.
grade 4 -	if the enthesopathy was exuberant.

Table 1. Enthesopathies analised by bone.

Bone	Enthesopathy	Enthesopathy	Enthesopathy	Enthesopathy
Clavicle	deltoid tuberosity Clav1			
Scapula	acromial ent. Sca1	coracoid process Sca2		
Humerus	medial epicondyle Hum1	lateral epicondyle Hum2	epitroclea Hum3	supracondilar lateral crest Hum4
Ulna	triceps brachii Uln1	cubitus ent. Uln2	ulnar tuberosity Uln3	
Radius	biceps brachii Ra1	radial tuberosity Ra2		
Os coxal	iliac crest Il1	isquion tuberosity Il2	"bridge" between ilium and sacrum Il3	
Femur	great trocanter Fe1	less trocanter Fe2	linea aspera Fe3	digital fossa Fe4
Patella	quadricipital tendon insertion Pat1			
Tibia	fossa solei T1	anterior tuberosity T2	distal part T3	inner maleolus T4
Fibula	biceps femoralis Fi1	lateral maleolus Fi2	membrane tibio-fibular Fi3	
Calcaneum	Achilles tendon insertion Ca1	adductor hallucis insertion Ca2		
Thoracic column	laminal spur CoT			
Lombar column	laminal spur CoL			

Laminal spurs, the enthesopathies on the yellow ligaments attachments, on the middle portion, anterior lamina surface and on their upper borders, were also classified according to 5 stages (Crubézy,1988).

grade 0 - missing value.
grade 1 - vertebra present but without laminal spur.
grade 2 - slight lesion (=1mm).
grade 3 - lesion from 1 to 4 mm high.
grade 4 - lesion higher than 4 mm.

Statistical Treatment

A database file was created with 41 variables. Each variable was coded numerically for statistical analysis. The statistical treatment was made with SPSS. To test the distribution of lesions by sex and ages at death, several X^2, from the Mann-Whitney test, were estimated as well as the Kendall's non-parametric coefficient of association. Whenever the sample was large enough, the traditional X^2 was performed.

Results

From figures 3 and 5, which concern the frequencies of the various types of enthesopathies analised, it is obvious that the great trend is to individuals without lesions (black bars).

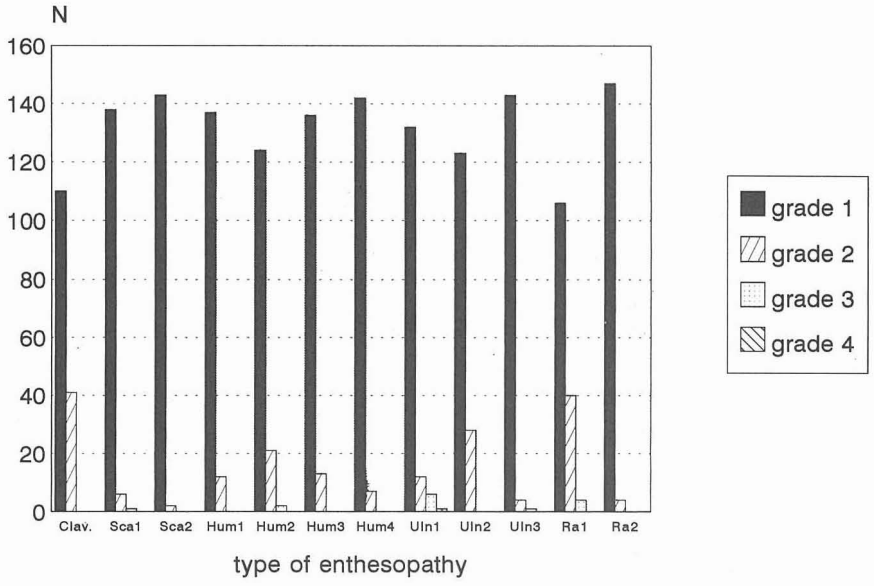

Fig. 3. Frequencies of each type of enthesopathic lesions affecting the upper limbs (both sexes).

In what the upper limbs are concerned, the two most frequent lesions are the ones affecting deltoid tuberosity in the clavicle (27.2%) and the lesion on the *radius biceps* muscle's insertion (26.7%). Besides, only the enthesopathic lesion on the ulna's triceps muscle insertion presented enthesopathies with maximum grade (grade 4-7.9%) (fig. 4).

The deltoid tuberosity (roughened and raised area of bone that lies on the anterior surface of the clavicle's lateral curve) marks the most medial point of the deltoid muscle's attachment, which is the principal elevator of the arm (Aiello and Dean, 1990). The highest incidence of this enthesopathy could be explained by the indispensable role of the clavicle in the shoulder stabilization. Clavicle is implied in movements such as force and stability, raising heavy loads as well as precision movements (Kapandji, 1968 *in* Ramos, 1990).

In what *biceps brachii* is concerned, which one of the insertions is on the bicipital tuberosity of the radius, it can function both as a flexor of the elbow and a supinator of the forearm (Aiello and Dean, 1990). Concerning its etiology, it is commonly found in populations that use their arms in strenuous activities.

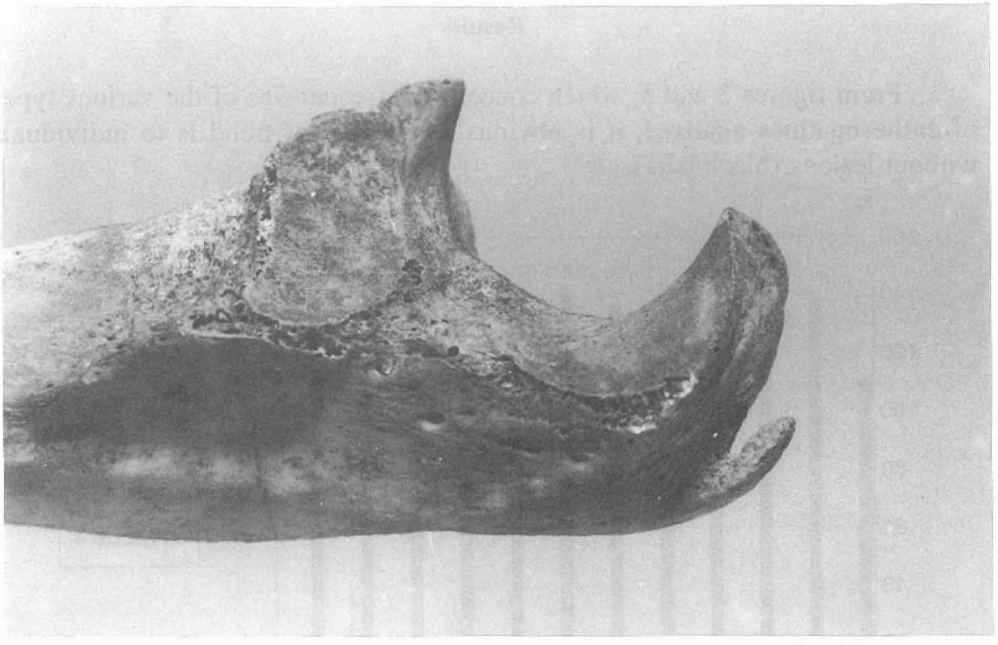

Fig. 4. Hypertrophic ossification of the olecranon process.

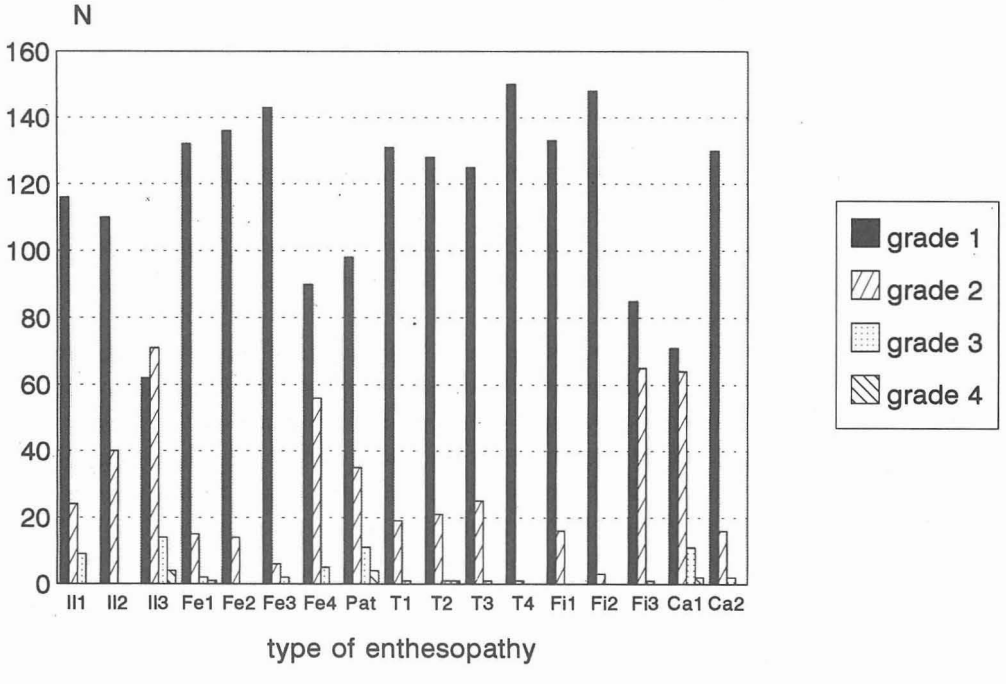

Fig. 5. Frequencies of each type of enthesopathy affecting the lower limbs.

Triceps brachii is the primary extensor of the elbow. It is a complex muscle with three heads of origin, consisting the major extensor of the forearm at the elbow, inserting on the olecranon process of the ulna (Aiello and Dean, 1990). With respect to the etiology of the *triceps brachii* enthesopathy, Mann and Murphy (1990 *in* Galera and Garralda, 1993) reported that it is commonly found in populations that use their arms in strenuous activities. During complete elbow extension and when the *triceps brachialis* muscle is fully extended and working at full power, its insertion site is subject to microtrauma (Dutour, 1986; Kennedy, 1989) These conditions are ideally met when the arm is horizontal and extended (Kapandji, 1983 *in* Ramos, 1990).

Concerning lower limbs, the enthesopathic lesion of the "bridge" between the ilium and sacrum is the only one where the number of individuals with lesions grade 2 (47%) is higher than the ones without any lesion. The lesions of the insertion of Achilles tendon's attachment on the calcaneous (52% of the individuals present this lesion) and on the tibio-fibular membrane (Fib3) (44% of individuals with the lesion) are the second more frequent. Maximum grade (grade 4) is reached by the enthesopathies on great trocanter (Fe1), on the bridge between the ilium and the sacrum (Il3), on the insertion of quadricipital tendon on the patella (Pat1), on the anterior tuberosity of the tibia (T2) and on the insertion of Achilles tendon's attachment on the calcaneous (Ca1) (fig. 6).

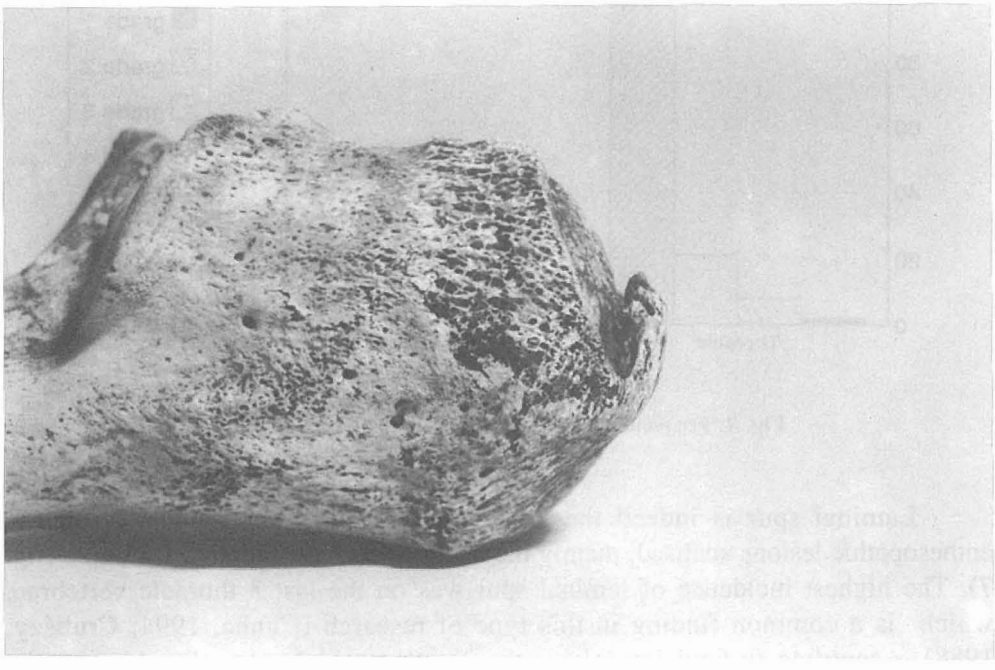

Fig. 6. Enthesopathy of the posterior heel in an adult male individual.

The most frequent lesion occur near the area of insertion of one of the main muscles of the pelvis, the *iliacus*, (Aiello and Dean, 1990), and where the sacro--iliac ligaments attach, which could mean that this area was very requested on the various activities. The pelvic bones are constantly subjected to mechanical pressures, consequence not only of the occupations but also of the locomotion itself. Nevertheless, it is difficult to separate the lesions provoked by degenerative processes from those provoked by microtraumatic processes (Crubézy, 1988).

The site where the tibiofibular enthesopathy occurs (Fib3) is a roughened area for the interosseous ligaments that bind the bones.

The calcaneal tuberosity is the insertion point of the Achilles tendon. Contraction of the gastrocnemius and soleus calf muscles causes plantarflexion of the foot, with the calcaneal tuberosity serving as a lever arm and the talar body as the fulcrum. Plantarflexor muscles, originating in the posterior side of the lower leg and attaching to the calcaneus via the Achilles tendon, contract at the time as the quadriceps (White and Folkens, 1991).

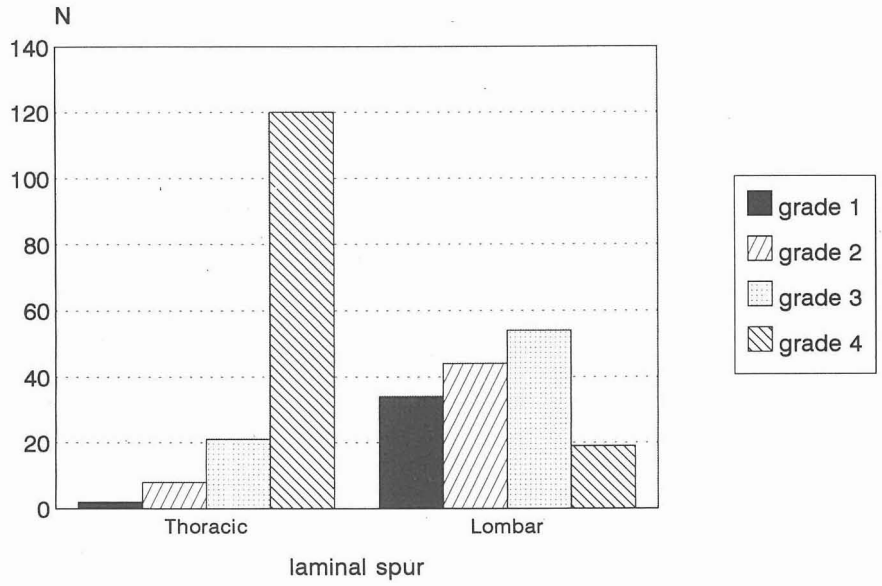

Fig. 7. Frequencies of thoracic and lombar laminal spur.

Laminal spur is indeed the most frequent and more severe of all the enthesopathic lesions analised, mainly the one affecting the thoracic vertebrae (fig. 7). The highest incidence of laminal spur was on the last 3 thoracic vertebrae, which is a common finding in this type of research (Cunha, 1994; Crubézy, 1988). According to Crubézy (1988) the vertebra which normally presents the highest frequency is the one above the thoracic-lombar junction. The majority of

these lesions are associated with microtraumatic phenomena due to dorsi-flexion and rotation movements. The ligament flavum is one of the ligaments that not only connect the vertebrae but also restrict movement of the spine (Aiello and Dean, 1990). The prevalence of laminal spur in thoracic spine, the less mobile part of the whole column, where the primary movement is rotation, let us suppose that the less mobile is the region of the column, the more enthesopathies occur and that rotation was indeed a very frequent movement.

The maximum percentage of more severe lesions (grade 4) is reached by thoracic vertebrae (fig. 8), where 78.8% of the individuals had exuberant laminal spur.

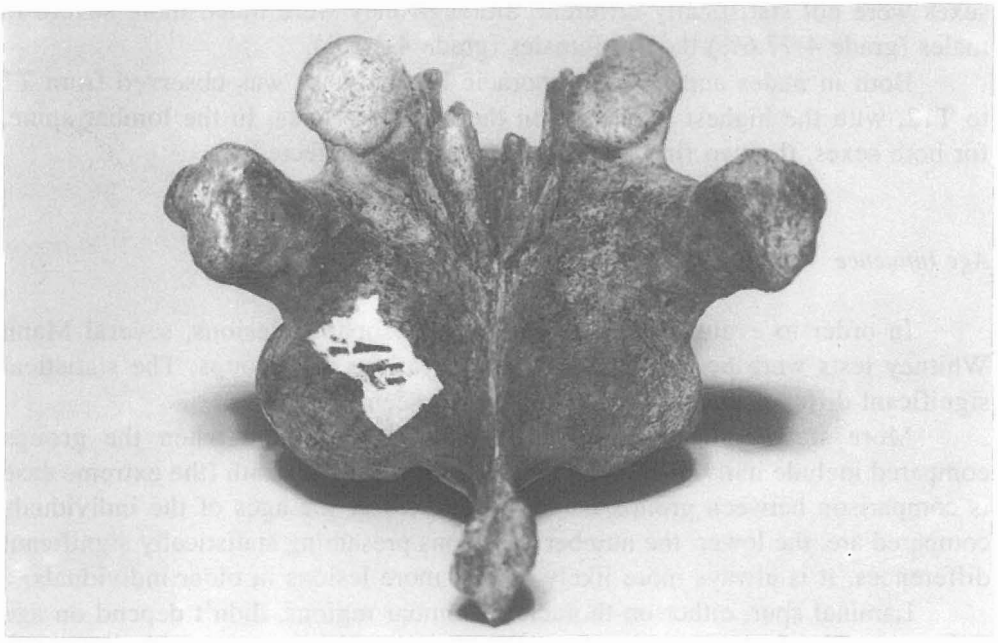

Fig. 8. Laminal spur on the thoracic vertebra.

Sex Distribution

When the frequencies of enthesopathies are analised between the sexes, in what the upper limbs are concerned, the trend is to females to present these lesions more frequently than males. However, only for the enthesopathy on the lateral epicondyle on the humerus (Hum2) (24.7% of females against 8% of males), ulna's triceps brachii insertion (Uln1) and radius biceps insertion (Ra1), the Mann-Whitney test was significant ($p<0.05$) after correction of ties. For this two latter lesions, however, the males showed more lesions (Ra1: 38.7% males against 20% females; Uln1,18% of males against 4% of females).

The prevalence of lateral epicondylites over the medial one is a classic result in medicine (*in* Ramos, 1990). The two epicondyles give insertion to muscles which allow the orientation of the hand in space as well as they ensure its power in effectiveness during gestures that need power and skill (Ramos, 1990). This occurs in occupations such as sewing women and housekeepers.

For the lower limbs there isn't any clear prevalence of lesions in one of the sexes. Only for iliac crest, females showed a significantly higher incidence of lesions (33.4% females against 10.9% of males). Heavy work, such as bearing heavy loads, can be at the origin of these lesions on the iliac crest.

Both for thoracic and lombar laminal spur, the differences between the sexes were not statistically different, although they were much more severe in males (grade 4-77.6%) than in females (grade 4-1.3%).

Both in males and females, thoracic laminal spur was observed from T1 to T12, with the highest incidence on the last three ones. In the lombar spine, for both sexes, the two first vertebrae are the most affected.

Age Influence

In order to evaluate age effects on enthesopathic lesions, several Mann Whitney tests were performed between the various age-groups. The statistical significant differences found ($p<0.05$) can be seen in table 2.

More statistically significant differences are found when the groups compared include individuals with very different ages at death (the extreme case is comparison between groups 1 and 5). The closer the ages of the individuals compared are, the lower the number of lesions presenting statistically significant differences. It is always more likely to find more lesions in older individuals.

Laminal spur, either on thoracic or lombar regions, didn't depend on age (X^2 not significant), but when Mann-Whitney is performed, we can see that when comparing groups 2 and 5 the occurrence of thoracic laminal spur depends on age ($p=0.03$), being the incidence higher in group 2.

Occupations versus Enthesopathies

To test whether enthesopathic lesions were more frequent in any of the occupational groups, several Mann-Whitney tests were performed among the various occupational groups. Statistically significant differences were found only for a very few number of lesions and after correction of ties. Besides, the values of significance were never high, in other words, the "p" was at the limit of the significant level (table 3).

Table 2. Statistical significant differences ($p<0.05$) on the incidence of enthesopathic lesions between age-groups.

Age Groups Enthesopathies	1-5	1-4	1-3	1-2	2-3	2-4	2-5	3-4	3-5
Clav1	X	X				X			
Sca1			X		X				
Hum1		X							
Hum2	X	X				X	X	X	X
Ra1	X	X	X			X			
Uln1			X						
Uln3		X							
Il1	X	X	X			X			
Il2	X	X							
Il3	X	X	X						
Fe1	X	X				X		X	
Fe2		X				X			
Fe3		X	X		X				
Fe4	X	X				X	X		
P1	X	X			X	X	X		
T1		X	X			X			
T2			X	X					
Fi1				X					
Ca1	X	X	X	X					
Ca2	X	X	X						
CoT							X		

Table 3. Statistically significant differences ($p<0.05$) on the incidence of enthesopathies among occupational groups (Mann-Whitney'X^2).
Legend: + indicates where the enthesopaties are more frequent.

Enthesopathies Occupational Groups	Hum1 p	Hum2 p	Hum4 p	Ra1 p	Uln1 p	Fe2 p	T3 p	Fi3 p
(1,4)				0.0375 +1	0.0377 +1	0.0129 +1	0.038 +1	
(1,3)							0.019 +1	0.02 +1
(2,4)					0.01 +2			
(2,5)	0.0 4 +2							
(3,5)							0.02 +5	
(3,4)		0.03 +4						
(4,5)			0.011 7 +5				0.0387 +5	

When the sexes were analysed separately, statistically significant differences were found only for males concerning the enthesopathy on the distal part of the tibia,when comparing individuals with various menial jobs with industrial and non-industrial workers (p=0.012), being the incidence higher in group 5.

Considering the low values of significance as well as the lower percentage of cases with lesions (for instances, for lateral epicondyle (Hum2) there were around 15% of individuals with lesion against 82% of individuals without it; for the supracondilar lateral crest (Hum4) these figures were, respectively, 6% and 94%), in all, none of these analyses give support to the hypothesis that occupations were related to the occurrence of enthesopathies.

The comparison of manual versus non-manual occupations made mainly through the comparison between the individuals with occupations implying stronger physical effort (group 1) with those where this effort was much smaller (group 3), doesn't give any evidence that being in a manual occupation was likely to develop enthesopathies.

In a way, this was an unexpected finding and seems to be at variance with the generally held view that the probability of developing enthesopathies is directly related to the physical effort involved in work.

Discussion

Starting the discussion by the relationship between the occurrence of enthesopathic lesions with occupations, heavier work didn't significantly increased the likelihood of enthesopathies.

One of the reasons of the obtained results could rely on the individuals'low socio-economic status, which is immediately evident after a first reading of their historical records. Here, socio-economic level is evaluated by means of the individuals' occupations. For the whole series, records indicate that while women belonged almost exclusively to domestic service, men were mainly rural workers and artisans (Group 1). The provenance of their bodies can also be considered a sign of their low socio-economic status. Since the majority of the skeletons came from the common burial ground of the "Cemitério da Conchada" in Coimbra, we can be almost sure that their families could not afford adequate burials (Cunha, 1995). Moreover, the analysis of multiple stress markers (enamel hypoplasia, Harris lines and porotic hyperostosis) in this collection also tends to support the obituary records, where a significant percentage of individuals have a low socio--economic level. The high frequencies of each of the mentioned stress indicators point to a high incidence of stress during childhood and adolescence (Cunha, 1995).

Difficulties arose when grouping the very large number of occupations in narrower categories, which could also have affected the results. Although we have been very rigorous in doing that, we admit small errors of misclassification. The problem could lie mainly on the fact that, except for occupational group 3 (industrial, non-industrial workers, etc), for all the groups the physical effort demanded was not that different. Nevertheless, it was expected, as already mentioned, that the individuals of group 1, which include, among others, carriers and rural workers, presented the highest prevalence of enthesopathies. But this was not the case. The prosecution of this work, i.e., the observation of enthesopathies on the remaing 133 individuals, which include a number, albeit small, of individuals with occupations belonging to medium socio-economic level, might modify this preliminary conclusion.

Other reason for our results could lie on the fact that some people recruit different muscles in the performance of the same task.

The considerations pointed by Dutour (1993) are also very pertinent for the explanation of our results. As the author points out, the sensitivity of a skeletal marker is not absolute. In a population practising the same sport with the same intensity, the development of this type of lesions is far from being generalized. Moreover, the several microtraumas provoked by a certain intense and repetitive activity, don't have all a visible translation on the osteoarticular system. The specificity of a skeletal marker established on the basis of actual occupations, is also fallible for 4 main reasons: "false positives" which correspond to the affections already mentioned and already eliminated from this analysis; a same marker can be common to several types of activities requiring each, analogous gestures; all skeletal markers are defined on the basis of actual activities and finally the general biomechanics of gesture is supposed to be the same nowadays and in prehistoric times. In conclusion, the specificity of an isolated marker is rarely absolute in relation to a certain activity (Dutour, 1993).

Our results did not evidence prevalence of enthesopathies in one of the sexes. Therefore, our findings don't support the statement that these non-pathological skeletal markers can provide evidence of sexual division of labour.

If we prove that from the analysis of enthesopathies in contemporary skeletons is difficult to arrive to eventual occupations, when leading with ancient skeletons, much more care is required.

Enthesopathies are not necessarily the result of a heavy work but more a consequence of a repetitive work done from very early. From certain genetic basis, enthesopathies become more severe in certain lifestyles (Wangermez *et al.*, 1986) and they are due to the concomitant action of microtraumatic processes as well as degenerative ones related with getting older (Crubézy, 1988). Enthesopathies are degenerative in nature and are "common in older individuals" (Resnick and Niwayama, 1988). Corroborating these authors, our results seem to point out that

enthesopathies are mainly age-related changes in the skeleton. When analysing age influence in the incidence of enthesopathies, our results clearly relate to an increase of prevalence of some enthesopathic lesions with increasing age. Degenerative changes seem to make the enthesis more vulnerable to microtraumas. This means that age is one of the most important etiological factors for enthesopathic lesions and consists of a criteria of exclusion when activities reconstruction is tried.

In agreement to our findings, the answer to the initial question, is that, on the basis of this sample of the Identified Skeletal Collection of Coimbra, bones do not tell a lot about labour and occupation.

Conclusions

With the Identified Skeletal Collection the opportunity arose to analyse the relationship between occupation and enthesopathies, since the occupations of all the individuals are known. This presents a unique opportunity. Enthesopathies are not widespread in this sample of the Collection. Moreover, some of the existing ones seem to be degenerative (related to age). Others, as laminal spur, occur in all ages, including the younger ones.

Our findings seem to support the statement that the role of occupational stress as a factor in enthesopathies is far from unequivocal.

In agreement with Goodman (1993), "the bones and teeth of the dead reflect conditions at death and conditions during life. They do tell tales about life processes, albeit ones that can be difficult to interpret" (pg.282).

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