PROGRAM - ABSTRACT BOOK

WORKSHOP IN MUSCULOSKELETAL STRESS MARKERS (MSM):

limitations and achievements in the reconstruction of past activity patterns

Department of Anthropology
University of Coimbra
Coimbra, Portugal
July 2-3, 2009
www.uc.pt/en/cia

CIAS

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Edited by
Ana Luísa Santos
Francisca Alves Cardoso
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PROGRAMME

PROGRAMME

Day 0 - Wednesday, 1st July, 2009

2:30-6:00 pm Opening of registration desk and poster set-up

Day 1 - Thursday, 2nd July, 2009

8:30 am Registration and poster set-up

9:00 am Welcome ceremony

Session 1 - Methodological issues
Chairperson: **Tony WALDRON**

9:45 am Keynote Lecture

MSM - Perhaps not a superstar but an important member of the team
Charles F. MERBS

10:20 am Oral presentations

Musculoskeletal stress markers (MSM): methodological reflections
Valentina MARIOTTI, Marco MILELLA, Maria Giovanna BELCASTRO

10:40 am *Enthesopathies as occupational stress markers: a reliable and reproducible method based on present medical data*
Sébastien VILLOTTE

11:00 am Coffee Break

11:15 am *A quantitative method for assessing MSM rugosity*
Charlotte Y. HENDERSON

11:35 am *The scientific value of using a 3D surface scanner to quantify entheses*
Doris PANY, Thomas VIOLA, Maria TESCHLER-NICOLA

11:55 am *Cross sections of radial tuberosity - geometrical properties, BMD distribution and effects of aging in MSM remodeling*
Milton NUNEZ, Sirpa NIINIMÄKI, Markku NISKANEN, Juho-Antti JUNNO

12:15 am *New directions in the analysis of musculoskeletal stress markers*
Cynthia A. WILCZAK

12:35 am Discussion and balance of the session

1:00 pm Lunch

2:00 pm ***Poster session 1***
Chairperson: **Sandra ASSIS**

The morphology of clavicular entheses observed on a sample of identified skeletons (SIMON collection, Switzerland): methodological discussion
Geneviève PERRÉARD LOPRENO

Entheses of the hands and studies of activity: possibilities and limitations
Aimee FOSTER, Hallie BUCKLEY and Nancy TAYLES

Reconstruction of labour intensity in Neolithic early agriculturalists from central Poland
Wiesław LORKIEWICZ, Marta KUREK, Agnieszka ŁĘGOCKA, Joanna URBANIAK

Musculoskeletal stress markers in Portuguese Late Neolithic population: What do they tell us?
Ana Maria SILVA

Musculoskeletal markers in the Bronze Age population from Motilla del Azuer (Daimiel, Ciudad Real, Spain)
Ihab AL OUMAOUI, Zita LAFFRANCHI, Maria G. ROCA, Sylvia A. JIMÉNEZ-BROBEIL

The costoclavicular ligament as an indicator of general workload: preliminary investigations
Renata L. F. PICALLUGA, Adilson D. SALLES, Cláudia RODRIGUES-CARVALHO

Session 2a - MSM studies: Applications to archaeological sample
Chairperson: **Charlotte ROBERTS**

3:00 pm Keynote Lecture

When Adam delved and Eve span, there were, of course, no gentlemen: Muscles, movements, and activity-related skeletal change

Christopher J. KNÜSEL

3:35 pm Oral presentations

Task-related changes in the dentitions of prehistoric skeletons from central Sudan
Tina JAKOB

3:55 pm *Interpreting patterns: A comparison of Near Eastern Neolithic MSM*

studies
Jane PETERSON

4:15 pm Coffee Break

4:30 pm *Enthesopathies and the various lifestyles of the inhabitants of the Great Moravian centre of Mikulčice (9th-10th century; Czech Republic)*
Petra HAVELKOVÁ

4:50 pm *Researching ancient behaviours: a biocultural approach to the study of musculoskeletal stress markers (MSM) in a skeletal sample from Constância, Portugal (14-19th centuries)*
Sandra ASSIS

5:10 pm Discussion and balance of the session

7:00 pm Reception *Sun set* at the City Hall

Day 2 - Friday, 3rd July, 2009

Session 2b - Applications to identified sample
Chairperson: **Jane PETERSON**

9:00 am Oral presentations

Can we derive occupation from enthesopathies? Lessons from the Coimbra Identified Skeletal Collection
Cláudia UMBELINO, Eugénia CUNHA

9:20 am *Musculoskeletal markers in a 20th-century Spanish sample. What can they contribute to the study of ancient populations?*
Sylvia A. JIMÉNEZ-BROBEIL, Maria G. ROCA, Ihab AL OUMAOUI, Zita LAFFRANCHI

9:40 am *On Human behaviour and storytelling: Gender, sex, age and muscular stress markers*
Francisca ALVES CARDOSO

10:00 am *Carrying loads and making shoes: skeletal markers of activity in a sample of porters and shoemakers from contemporary Italy*
Marco MILELLA, Stefania ZAMPETTI, Maria Giovanna BELCASTRO, Valentina MARIOTTI

10:20 am Discussion and balance of the session

10:45 am Coffee-break

Session 3 - Multifactorial etiology of enthesopathies
Chairperson: **Sébastien VILLOTTE**

11:00 am Keynote Lecture

Understanding "musculoskeletal stress markers: "Their multifactorial etiology and constraints on simplistic interpretations
Robert JURMAIN

11:35 am Oral presentations

The cost of lifestyle revisited: Musculoskeletal stress markers (MSM) in Brazilian prehistoric coastal populations. Methodological and interpretation challenges
Cláudia RODRIGUES-CARVALHO

11 :55 am *Incipient DISH and MSM: Diagnosis and problems of interpretation in the lower limb*
Paula KYRIAKOU

12:15 am *Enthesial lesions and spondylarthropathies: clinical and paleopathological insights*
Carina MARQUES

12:35 am Discussion and balance of the session

1:00 pm Lunch

2:00 pm **Poster session 2**
Chairperson: **Francisca ALVES CARDOSO**

Enthesopathies as "pregnancy markers": consideration of a large archaeological sample of hip bones
Annalisa CONZATO, Jasmine RIZZI

Musculoskeletal stress markers in the prehispanic archaeological site of El Agujero (Gran Canaria, Spain). Preliminary results
Jonathan Santana CABRERA, Javier Velasco VÁZQUEZ, Martha Alamón NÚÑEZ, Amelia RODRÍGUEZ-RODRÍGUEZ

Stress markers on Pre-Columbian skeletons from San Lorenzo Island: A Weavers's Cemetery?
José Antonio Hudtwalcker MORÁN, Guido P. LOMBARDI, Uriel GARCÍA-CÁCERES

	The auricular surface - a 'dead end' or a misunderstood resource? **Ian MAGEE**
	Musculoskeletal markers in the toes: population data from early twentieth century Lisbon, Portugal **Hugo F. V. CARDOSO, Vanessa CAMPANACHO, Eunice CONCEIÇÃO, José GOMES**
	Iconographic approaches to the study of musculoskeletal stress markers **Sandra ASSIS, Maria do Rosário MARTINS, Maria Arminda MIRANDA, Ana Luísa SANTOS**
3 :00 pm	**Plenary session**
	Moderator: **Ana Luisa SANTOS**
	Annotators: **Charlotte ROBERTS** and **Tony WALDRON**
4 :00	Coffee-break
4:15 pm	General discussion and elaboration of a list of recommendations for future studies
5:30 pm	**Closing session**
	Farewell wine tasting - Bairrada Wine Commission

ABSTRACTS

On human behaviour and storytelling: Gender, sex, age and *muscular stress markers*

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Oral

Reconstructing human behaviour through the media of skeletal analysis is not as straightforward as it first appears. This work explores the assumption that the sexual division of labour in society leaves activity-related physical markers on the skeleton, specifically Muscle Stress Markers (MSM), which could be used to reconstruct Gender. The reasoning is that differential sex-related activities leave marks on the skeleton, and these marks can be used to differentiate activity-related behaviour, which could then be Gender, or class related. To test this hypothesis robusticity markers, as described by Hawkey and Merbs (1995), were recorded on 28 entheses of 603 male and female adult skeletons. The skeletons were selected in two identified skeletal Portuguese populations of the 19th and 20th centuries. The results showed that age at death of the individuals was a major confounding variable, and that some of the sex MSM-related associations were age biased. Furthermore, the majority of females were historically grouped into a single occupational category, *housewives*. This category proved to be an insurmountable bias whilst analysing MSM and occupational groups. Overall, two major set of problems arise from these observations: one related with the multifactorial nature of MSM, which may bias any activity-related inferences; the second relates to the historical framework of the social construction of male/female categories. Consequently, activity–related bony changes are presently not the best proxy from which one may infer human behaviour; *social constructions* are not *biologically identifiable traits* in skeletal material. In conclusion, there is a fine line between reconstructing human behaviour based on human skeletal material, both physical and social, and storytelling.

Keywords: 19th and 20th centuries; Portugal; Lisbon and Coimbra Identified skeletal collections

Hawkey, D. and Merbs, C. F. (1995). "Activity-induced musculoskeletal stress markers (MSM) and subsistence strategy changes among ancient Hudson Bay Eskimo." *International Journal of Osteoarchaeology, 5(324-338)*.

Researching ancient behaviours: a biocultural approach to the study of musculoskeletal stress markers (MSM) in a skeletal sample from Constância, Portugal (14-19th centuries)

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Oral

Paleopathological studies have revealed a connection between some types of bone lesions and the stress produced during the performance of certain activities. The biocultural approach here presented aims to combine the skeletal evidence, through the study of musculoskeletal stress markers (MSM) in a sample from both sexes (N=64) exhumed from the Constância necropolis (14th-19th centuries), with historical, ethnographic and economic data, indicating that fishing and ship building were dominant occupations among the inhabitants. Thirty-six body MSM sites were scored using the method of Mariotti *et al.* (2004). In the upper limb, the MSM mean scores were higher in females than males. The opposite was noted for the musculoskeletal insertions of the lower limb. In males, alterations at the costoclavicular ligament predominate, while in females those of the *supinator* muscle were most frequently observed. The lower limb MSMs most affected were the *quadriceps femoris* muscle in males, and the *gluteal* muscles in females. The sexual dimorphism was higher in females with respect to upper anatomical sites. Age at death proved to be a contributing factor to increased MSM values. Significant results were obtained in male individuals in the musculoskeletal groups involved in rowing, revealing a possible connection with the historical records which refer to man being actively involved in this activity. From the MSM results, as well as from some degenerative joint disease data, it is possible to conclude that the ancient inhabitants of Constância would have been subjected to acute episodes of biomechanical stress.

Key Words: paleopathology; musculoskeletal insertions; bone outgrowths; interdisciplinary approach; occupation

Mariotti V, Facchini F, Belcastro MG. 2004. Enthesopathies: proposal of a standardised scoring method and applications. *Collegium Antropologicum,* 28: 145-159.

Iconographic approaches to the study of musculoskeletal stress markers

Sandra ASSIS[1], Maria do Rosário MARTINS[1,2], Maria Arminda MIRANDA[1,2], Ana Luísa SANTOS[1]
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Poster

Reconstruction of past human lifestyles represents an enormous challenge since human behaviour does not fossilize. Nevertheless, a profound gap remains between the type of bone lesion observed and the biomechanical stress produced by human movements. As a result, a biocultural approach that joins the biological information obtained from the skeleton with historical and ethnographic information has been proposed (Robb, 1994). In this perspective involving the ethnographic study of material culture, iconographic portrayals and written documents are significant sources for the interpretation of everyday activities. The aim of this work is to consider the usefulness of iconographic collections in the difficult task of understanding the musculoskeletal effects of occupation in past populations. Starting from a corpus of artefacts from Africa representing fishing and hunting activities and stored at the Museum of Anthropology at the University of Coimbra, certain hypotheses can be addressed: Is it possible to infer the precise body posture and movements? What kind of information can we obtain about sexual labour division? Is it possible to evaluate the effects of those behaviours over the musculoskeletal apparatus? What are the advantages and drawbacks of this analysis, namely applying information from one region and chronology to a different one? Although there are serious interpretative limitations in the absence of a biological record, we can assume that these activities must have imposed some biomechanical constraints in the iconographical groups represented. After all, the study of material culture can give some clues in the study of MSM.

Key Words: biocultural approach; material culture; physical stress; fishing and hunting

Robb, J. 1994. Skeletal signs of activity in the Italian metal ages: methodological and interpretative notes. *Human Evolution,* 9: 215-229.

Musculoskeletal stress markers in the prehispanic archaeological site of El Agujero (Gran Canaria, Spain). Preliminary results

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Poster

The Canary Islands were first colonizated by Berber-like people from North Africa in the second half of the first millennium BC. This period finished in the 15th century AD when Europeans conquered the Islands. First historical written records about the contact of the ancient Canarians and the European colonizers and archaeological data suggest that in Gran Canaria Island there was a stratified social system based on intensive agriculture economy with a clear pattern of social division of work. The musculoskeletal stress marker (MSM) has never been applied in archaeological studies from Gran Canaria Island. Our main goal is to detect intra-population similarities and differences based on MSM data collected from one ancient skeletal series: 32 individuals from El Agujero Necropolis (coast line of Northern Gran Canaria Island). This archaeological site was occupied during the last phase Pre-European (A.D. 11th-14th). The skeletal population was analyzed using a visual reference system based in Galtés *et al.* (2006) method for recording MSMs on the upper extremities. The available bioarchaeological data on the prehispanic population from El Agujero are making the study of MSMs an essential tool to complete the understanding of lifestyles of this group. Furthermore, the notorial hierarchy of the burial spaces makes the analysis of musculoskeletal markers a key tack for the reconstruction of the social division of labor. We have detected similarities and differences in MSM expression, sexual dimorphism and bilateral asymmetry that may be due to daily routine activities practiced by El Agujero population. Results of this study support previous data obtained from ethnohistorical and archaeological sources.

Key Words: Canary Islands; prehispanic stage; musculoskeletal stress markers; sexual dimorphism; bilateral asymmetry

Galtés I, Rodríguez A, Malgosa A. 2006. Mechanical morphogenesis: a concept applied to the surface of the radius. *The anatomical record part A*, 288A: 794-805.

Musculoskeletal markers in the toes: population data from early twentieth century Lisbon, Portugal

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Poster

The purpose of this study is to determine the frequency of ridges of tendon attachment (digital flexors) on the medial and lateral sides of the proximal phalanges of the lateral four toes, a rarely reported skeletal change. A sample of Portuguese adult identified skeletons (females=103; males=102) from the Lisbon collection was selected. Ages range from 18 to 94 years. All available phalanges were observed macroscopically for the presence/absence of tendon ridges. Prevalence was calculated as the percentage of individuals showing ridges at least in one phalange. Frequency was calculated as the percentage of phalanges with ridges. Both prevalence and frequency tend to be higher in males (males: prev.=70.6%, freq.=46.9%; females: prev.=59.2%, freq.=36.6%) and older age groups (females: [18-39] years: prev.=26.7%, freq.=13.2%; [40-59] years: prev.=65.2%; freq.=32.1%; ≥60 years: prev.=64.6%, freq.=43.9%), but do not differ between occupational categories (males, manual: prev.=68.1%, freq.=47.0%; non-manual: prev.=72.7%, freq.=46.9%). Since phalanges could not be sided, lateral differences were not determined. The detection of these ridges is heavily influence by preservation and completeness of skeletons. In addition, these markers probably represent a structural reinforcement of the diaphysis and can result from a combination of activities which involve flexing of the toes. This may make these changes unreliable as sources of information about any specific activity. Nonetheless, results indicate a relatively high frequency of these changes in a modern type urban population, which may serve as comparative data for other contemporaneous or archaeological populations and aid in the future understanding of its origin and development.

Key Words: foot phalanges; fibrous entheses; Portugal; early 20th century; population data

Enthesopathies as "pregnancy markers": consideration of a large archaeological sample of hip bones

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Poster

The excavation at St. Floriano Chapel (1249 A.D.), Rio di Pusteria (Italy), produced approximately 30 m³ of bones. The charnel house was the result of centuries of bone unearthing from the adjacent cemetery. A detailed study was made of 1375 adult pelvic bones. The study focused on enthesopathies as "pregnancy-childbirth markers". The skeletal alterations found on the hip bone, according to some researchers, can be linked to pregnancy and to giving birth. These markers can be considered enthesopathies because they would be the result of a mechanical action on specific ligamentous and tendinous attachments. We studied these alterations in order to assess the fertility of the population. Markers were recorded using the method proposed by Kelley (1979), who considered some bony changes significantly related to parturition. The presence or absence, the shape, and extent of the preauricular and interosseous sulcus, as well as the presence or absence and the extent of pits on the dorsal aspect of the pubic body, and the extension of the pubic tubercle were evaluated in relation to age and sex. There is the tendency for an increasing number and depth of scars with increasing age. Some male hip bones possess dorsal pits and deep grooves, which call into question the causal factors involved in producing the scars; as previously reported by other authors. They are, however, very important in order to determine sex.

Key Words: enthesopathies; pregnancy markers; pubic pits; preauricular interosseous grooves; pubic tubercle

Kelley MA. 1979. Parturition and pelvic changes. *American Journal of Physical Anthropology*, 51:541-546.

Entheses of the hands and studies of activity: possibilities and limitations

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Poster

While studies of entheses and activity often focus on the upper limb, no study to date has included the entheses of hand bones. This is surprising given that it is the specialised function of the human hand that allows us to uniquely manipulate our environment in daily activities. Furthermore use of the hand is in fact the end point of all other upper limb movements. The exclusion of entheses of the hands in other studies may result in the loss of important information pertinent to the understanding of prehistoric activity. Therefore, this poster explores the usefulness of including entheses of the hand in activity studies. Results of data collected from Neolithic and Bronze Age (1650-420 BC) skeletons of the Ban Non Wat, Thailand skeletal sample will be presented, which demonstrate the level of developmental variation observable in entheses of the hand. Some preliminary findings regarding muscle use and activity at Ban Non Wat are also presented. While males demonstrate greater development than females in all entheses of the upper limb, this is most likely due to the difference in body size between these two groups. Analysis of ranked mean scores for entheses of the hand does however show differences in the use of muscle groups between males and females at Ban Non Wat.

Key Words: methodology; hands; Ban Non Wat; Thailand; 1650-420 BC

Enthesopathies and the various lifestyles of the inhabitants of the Great Moravian centre of Mikulčice (9th -10th century; Czech Republic)

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Oral

The occurrence of enthesopathies is associated with muscle insertion sites and physical activities. The aim of this work was to analyse the differences in the occurrence of cortical defects at the attachment sites of individuals living under different life conditions. The skeletal material comes from the cemeteries of the Great Moravian settlement agglomeration of Mikulčice - Valy and its hinterland (9th-10th century AD). Enthesopathies were recorded on 126 skeletons buried in the 3rd church founded in Mikulčice in the area of the castle itself (suggestive of higher social status) and 84 individuals from the burial-grounds of Prušánky and Josefov considered to be located in the agriculture hinterland. The scoring of the 36 insertion sites of the appendicular skeleton and 46 insertions of ligamentum flavum of the vertebral column were evaluated following the method of Villotte (2006). Statistical analysis indicates that there are significant differences in occurrence of enthesopathies between the castle and hinterland groups. Higher prevalence of markers was recorded in the lower limbs of the castle group but in the upper limbs of the hinterland group. Sexual dimorphism of the enthesopathies is more evident in Prušánky and Josefov, where the differences were statistically significant for 12 insertion sites. Higher occurrence of enthesopathies was recorded in males from the hinterland, and in females from the castle. This study confirmed the archaeological hypothesis with regard to social differences between the inhabitants of Mikulčice settlement agglomeration and its hinterland.

Key Words: enthesopathies; Great Moravia; 9th-10th century; life conditions

This project was financed by grants from the GAČR 206/03/0699 and the Czech Ministry of Culture VZ PM MK00002327201.

Villotte S. 2006. Connaissances médicales actuelles, cotation des enthésopathies: nouvelle méthode. *Bulletins et Mémoires de la Société d'Anthropologie de Paris* 18: 65-85.

A quantitative method for assessing MSM rugosity

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Oral

The aim of this study was to determine whether surface roughness parameters could be meaningfully used to describe fibrocartilaginous entheses. The sample used to test the method on, was the medieval site from Fishergate House, York, England (n=43). All individuals used were male based on pelvic morphology. All skeletons were included in the study, even if they had evidence of diffuse idiopathic skeletal hyperostosis (DISH), but these were grouped separately, to determine whether the surface roughness of these entheses differed from the rest of the sample. Three entheses were chosen: the supraspinatus insertion, common extensor origin, and biceps brachii insertion. A two dimensional approach was used to record entheses using a profile gauge, which was placed against the enthesis crossing its midpoint in both an x and y axis (intersecting at 90 degrees). The profile was drawn on paper, scanned in, and the bitmap file was run through a routine in Matlab 5.3, which calculated predetermined surface roughness parameters. The results of the study demonstrated statistically significant differences in surface roughness parameters between entheses with enthesopathies and those without. Entheses in individuals with DISH differed in roughness from the two other groups. Surface roughness parameters have been found to be useful in describing the surfaces of these three entheses. The method was found to be repeatable and have non-statistically significant (p=0.05) inter and intra-observer error. This makes it easy to use and widely applicable to archaeological samples. Further tests are required to ascertain whether differences in surface roughness exist between different occupational groups. In conclusion, this study demonstrated that many of the inferences made by bioarchaeologists regarding MSM are overly simplistic.

Key Words: roughness parameters; profile gauge; Fishergate House, York; Medieval; methodological study

Stress markers on Pre-Columbian skeletons from San Lorenzo Island: A Weavers's Cemetery?

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Poster

Among its many attractions, San Lorenzo Island holds a wealth of paleoanthropological specimens. The main focus of research is to explore Pre-Columbian burial practices and characteristics of the peoples buried on the Peruvian island. While previous studies focused on 17th through 19th-century 'pirates' and soldiers, the results reported in this contribution represent the first paleopathological study of a Pre-Columbian island's cemetery, and, particularly, the evidence of stress markers on bone. A funeral bale with human bones remains called "Individual VIII", an elderly female of approximately 55 ± 5 years old at death, culturally dated to the 16th century A.D., presents degenerative lesions compatible with overuse involving both upper limbs over a long period of time. The studies (CT-Scan and macroscopic analysis) allowed to observe several lesions, these include symmetrical OA of the elbows with adjoining enthesopathies and nodular bone overgrowth in the *fossa olecrani*. Among other findings, the skeleton presents OA of the inferior portion of the vertebral column. These findings have been interpreted as MSM representative of an occupational pathology of a person who performed a repetitive and symmetrical hyperextension of both upper limbs. Both tomb paraphernalia and ethnohistorical data indicate that this woman was a weaver.

Key Words: 16th-century AD; paleopathology; CT-Scan & macroscopic analysis; occupational stress; elite burial

Task-related changes in the dentitions of prehistoric skeletons from central Sudan

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Oral

The use of teeth as a third hand has been described in numerous publications, trying to identify a range of activities such as basket making, fibre processing or even spinning. The aim of the present study was to establish whether differences in non-masticatory tooth use could be identified in the mandibles and dentitions of 38 Mesolithic (7th-6th millennium BC) and 18 Neolithic (4th millennium BC) individuals from the cemetery of Al-Khiday 2 (Khartoum Province). This analysis evaluated five muscles attachment sites on the mandible (temporalis, masseter, medial and lateral pterygoid and mentalis muscles) for their presence or absence of changes, in conjunction with a macroscopic study of dental wear as well as changes in the shape of the mandibular condyles caused by osteoarthritis (OA). There were clear differences between the two populations with pronounced muscle attachment sites in the Mesolithic individuals being more frequent and mandibular condyles had developed a flattened and enlarged shape due to OA. Only Neolithic people displayed lingual surface attrition of the maxillary anterior teeth (LSAMAT), while Mesolithic teeth showed a large number of occlusal and interproximal grooves. However, differences between the sexes within these populations were less readily identifiable. The observed differences will be discussed with regard to different subsistence strategies and activities employed by these prehistoric people. However, while variations in muscle use could be demonstrated, it is felt that without a detailed analysis of individuals with documented cases of non-masticatory tooth use, it is not prudent to single out individual tasks.

Key Words: Mesolithic; Neolithic; MSM; OA; non-masticatory tooth wear

Musculoskeletal markers in a 20th-century Spanish sample.
What can they contribute to the study of ancient populations?

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Oral

The first aim of this study was to analyze some MSM in a 20th-century population from the city of Granada (Spain) in order to obtain comparative references for future studies of ancient populations. The sample contains 109 individuals (55 males and 54 females) with known sex and age, and in a good state of preservation. They come from the cemetery of the city of Granada. There are no records of the work and occupations of these individuals but, because of the circumstances of the burials, it can be assumed that they did not belong to the upper social classes. The mean age of the sample is about 69 years. The MSM studied were selected according to the procedures proposed in Al Oumaoui *et al.* (2004). Both sexes present a high frequency of MSM, which was more than 50% for some markers. Only two significant differences were observed: higher frequency of greater trochanter in females and of tibial tuberosity in males. We have made comparisons with other ancient populations and discussed the difficulties of studying these markers in elderly people because they give a misleading appearance of strong muscular development, especially in postmenopausal females.

Key Words: 20th century; Spain; elderly people

Al Oumaoui I, Jiménez-Brobeil SA, du Souich Ph. 2004. Markers of activity patterns in some populations of the Iberian Peninsula. *International Journal of Osteoarchaeology* 14: 343-359.

Understanding "Musculoskeletal Stress Markers:"
Their Multifactorial etiology and constraints on simplistic interpretations

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Lecture

Although the study of musculoskeletal stress markers has become more common in recent years, from its outset most of this research has been based on the *a priori* assumption that skeletal remodeling at enthesial sites is clearly the result of activity. Such an inference is simplistic, particularly when considering bone physiology and what has been learned of similar mechanisms underlying the etiopathogenesis of osteoarthritis. The underlying basis for these overly simplistic interpretations leads to an inescapable circular reasoning, from which the only solution is some means of independent testing. In well-grounded paleopathological analyses, adequately documented clinical data are typically the best avenue to evaluate and independently provide a means for testing bioarchaeologically-derived hypotheses. Those data available from a few experimental studies and analyses of well-documented historical samples suggest the etiology of "MSM" is multifactorial and is almost certainly *not* entirely, or even primarily, the result of activity. From the available specific clinical research as well as an understanding of relevant bone physiology, we can (at minimum) reasonably hypothesize the following factors influencing the etiology of enthesial bone changes: Genetic/developmental effects, age, sex, preexisting pathological conditions or trauma, body size, and perhaps diet. Current research strongly suggests that, in combination, these factors explain >50% of intra- and inter-population variance of so-called "MSM." Lastly, even assuming activity might be another potentially important factor, its influence most likely occurs during childhood or adolescence. Accordingly, it is becoming increasingly apparent that simplistic interpretations of "MSM" as reliable indicators of habitual adult activities are scientifically untenable.

Key Words: activity; enthesial bone changes; scientific verification

When Adam delved and Eve span, there were, of course, no gentlemen: Muscles, movements, and activity-related skeletal change

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Lecture

Phenotypic adaptation is central to the nature/nurture debate. The emerging and increasingly sophisticated study of the acquired component of skeletal morphology complements those of the human genotype in modern and past human populations. Among the most important of these phenotypic characteristics of skeletal form are those resulting from heightened physical activity, some of which have been associated with specific forms of repeated and strenuous movements. These studies have benefited from the long diachronic sweep of the archaeological record, specifically concentrating on population-based studies of human limb cross-sectional morphology and bilateral asymmetry, musculo-skeletal markers of stress (MSM) and degenerative conditions. Other conditions can be linked to the diagnostic criteria of more recently identified occupational diseases that result from postures assumed in carrying out certain movements or from trauma incurred as a result of overuse. This treatment considers skeletal adaptation in response to both heightened physical activity (i.e. capacity), as well as that deriving from inactivity or incapacity. Together, these studies document a natural history of skeletal adaptation, while also providing a means by which to assess the social consequences of skeletal morphology from consideration of archaeological contexts.

Key Words: activity; occupation; osteoarthritis; capacity; incapacity

Incipient DISH and MSM: Diagnosis and problems of interpretation in the lower limb

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Oral

The prolific diathesis of DISH produces enthesopathies that could be mistaken for musculoskeletal stress markers (MSMs). Without the classic manifestation of anterolateral ankylosis at the right aspect of the thoracic vertebrae, DISH could go unnoticed. However, a pattern of osteophytic enthesopathies in lower limb muscle/tendon/ligament sites could be diagnostic for extra-spinal manifestations of incipient DISH. Alternatively, these enthesopathies could be mistaken as simply MSMs related to repeated activity. Morphological similarities between MSM and extra-spinal expressions of DISH in the lower limb generate a practical problem of identification and interpretation. With reference to four medieval sites from Scotland (Whithorn Priory, St. Andrew's Library, St. Giles' Cathedral, St. Roque's Chapel), the presence, absence and combination of certain markers has been identified to aid distinguishing between the two in both articulated and disarticulated skeletal material. The aim of this paper is to provide a differential diagnosis for the presence of MSMs in the lower limb, showing that the cause of their appearance could be other than mechanical loading. Extra-spinal DISH produces a pattern of prolific changes found at the iliac crest, sacroiliac joint, anterior patella, trochanteric fossa, greater/lesser trochanter, gluteal tuberosity extending along the linea aspera, and calcaneus (Achilles tendon). The presence of *Poirier's* facet and the degree of enthesopathy in conjunction with the socio-historical background of the burials aided in the differentiation between DISH and activity-induced enthesopathies. The result points towards the insufficient practicality of correctly interpreting MSM in past populations, and the importance of placing skeletons into context prior to interpretation.

Key Words: Medieval; Scotland; enthesopathy; differential diagnosis; biocultural approach

Reconstruction of labour intensity in Neolithic early agriculturalists from central Poland

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Poster

The aim of the study is to evaluate the patterns of physical activity in early Neolithic population (4600-4000 BC) from the Kuiavia region of central Poland. The skeletal sample consists of 64 adult individuals, 35 males and 29 females. Two comparative series from the same microregion were also analyzed: medieval (13th-16th century AD; 100 skeletons) and early modern (17th-18th century AD; 60 skeletons). Thirteen muscle insertion sites (MSM) on the upper and lower limb bones and one ligament site (costoclavicular syndesmosis on the clavicle) were examined in the three skeletal samples. MSM scores were recorded according to a visual reference system analogous to that devised by Hawkey and Merbs (1995). In addition to MSM analysis, mechanical skeletal properties were quantified on the basis of external measurementss of diaphyseal robusticity, and body mass and height were also estimated using the method proposed by Stock and Shaw (2007) and the Pearson formulae (1899), respectively. Both data sets were analysed with regard to age at death, body size, sexual dimorphism and bilateral asymmetry. The indices of skeletal robusticity were used to verify the validity of information which has been obtained by MSM study. When compared to the other sites, the Neolithic population is characterized by the lowest values for stature but the highest for robusticity and body mass. It also has little sexual dimorphism in the size and robusticity of the limb bones. Differences in MSM expression confirm high physical demands imposed on the people by the subsistence strategy of these early agriculturalists, especially in the upper limbs.

Key Words: Neolithic; agriculture; Poland; applied study

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The auricular surface – a 'dead end' or a misunderstood resource?

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Poster

In recent years 3 main attempts have been made to devise a method of estimating age-at-death using the auricular surface of the IS joint: Lovejoy *et al.* (1984), Buckberry and Chamberlain (2002) and Igarashi *et al.* (2005). Whilst differing somewhat in their formulation, application and labelling, all identify the same features in attempting to chronologically account for the appearance of the joint surface. However, if the impact of lifetime activity/occupation on the joint is not considered, features may be included in methodologies that have no chronological application. If a correlation between MSM presence on the ilium and surface features associated with lifetime activity is demonstrated, this could facilitate the refinement of age-at-death estimation techniques which use joint surfaces, by cataloguing features as bio-cultural manifestations rather than chronologically measurable degeneration. By extension, reinterpretation of features in the context of lifetime activity may contribute to our consideration of how age was defined and socially applied in the past. The auricular surfaces of 101 individuals (33 males and 68 females) from the Spitalfields named collection were inspected and all features were catalogued. Correlation was sought between the occurrence of features and MSM appearance on the ilium through macroscopic observation. Initial observations seem to suggest a relationship between certain features and the presence of MSM on the ilium. If shown to be consistent throughout the study, this will shed light upon the impact of lifetime activity on the joint and facilitate further refinement of methodologies using the auricular surface to estimate age-at-death.

Key Words: social age; auricular surface; Spitalfields; age-at-death; applied study

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Musculoskeletal stress markers (MSM): methodological reflections

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Oral

The aim of bioarchaeological studies of human remains is to investigate ancient human societies from a biocultural point of view. In particular, the so-called "musculoskeletal stress markers" (MSM; Hawkey and Merbs, 1995), i.e. the degree of development of entheses and enthesopathies, have been used to reconstruct past activities. However, this research field is affected by three main problems: the ambiguity of the terminology used; the lack of standardized scoring methods shared by all researchers, preventing the reproducibility and comparability of the observations; and the interpretation of the results. In fact, osseous traits generally have a multifactorial etiology, and the effects of age, sex, individual factors, pathologies, physical activity, etc., generally overlap. The aim of this presentation is to discuss these problems. The standardized scoring methods for entheses and enthesopathies developed by our research group will be presented (Mariotti *et al.* 2004, 2007). The results of our research concerning the interpretative possibilities of MSM will also be shown. For this study, we analysed the skeletons of approximately 500 adult individuals of both sexes from modern identified (sex, age, occupation) collections (Frassetto collections, early XX c., Italy). The study of these collections allowed the evaluation of the relationship between the MSM and the age, sex and occupation of the individuals.

Key Words: entheses; enthesopathies; modern identified skeletal collections, standardised scoring method; Italy

Hawkey DE, Merbs CF. 1995. Activity-induced Musculoskeletal stress markers (MSM) and Subsistence strategy change among Ancient Hudson Bay Eskimos. *International Journal of Osteoarchaeology*, 5: 324-38.

Mariotti V, Facchini F, Belcastro MG. 2004. Enthesopathies - Proposal of a standardized scoring method and applications. *Collegium Antropologicum*, 28: 145-159.

Mariotti V, Facchini F, Belcastro MG. 2007. The study of entheses: proposal of a standardised scoring method for twenty-three entheses of the postcranial skeleton. *Collegium Antropologicum,* 31: 191-313.

Enthesial lesions and spondylarthropathies: clinical and paleopathological insights

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Oral

The concept of spondylarthropathies encompasses a group of distinct clinical entities that share a set of common features, such as: inflammation on the axial segment, peripheral arthritis, enthesitis, mucocutaneous inflammatory lesions and genetic predisposition, and a close link to the HLA-B27. Within the musculoskeletal system, the inflammatory processes can induce severe changes on the enthesis and synovial and cartilaginous joints. Therefore, these rheumatologic conditions can be easily recognized as a significant etiological factor on enthesophyte formation. This implicates that skeletal biologist must take into account the influence of rheumatic conditions when inferring human activity patterns from the analysis of enthesial new bone formation. A research performed on 573 adult individuals (314 females and 259 males), from the Identified Skeletal Collection from the Museu Bocage (Museu Nacional de História Natural, Lisboa), dated from the 19th to the 20th century, and that aimed the study of the skeletal manifestation of spondylarthropathies will be the starting point to frame the discussion concerning the expression of enthesitis in spondylarthropathies. This will be complemented by a review of clinical research concerning this issue, as well as, an approach to the limits and constrains of the paleopathological interpretation of these conditions.

Key-Words: Rheumatology, paleopathology, 19th-20th century, Portugal, enthesophyte

MSM - Perhaps not a superstar but an important member of the team

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Lecture

Early efforts to identify occupation or other patterns of behavior from changes in the human skeleton included marks that occurred where a muscle tendon or ligament inserts onto the periosteum and into the underlying bony cortex. Originally called enthesopathies, they are now most commonly referred to as musculoskeletal stress markers (MSM), a term originated by Hawkey and Merbs in 1995. Although I have produced students who have analyzed MSM in complete skeletons of various series (East Central and Southwestern Native Americans, Canadian Inuit, Meroitic Nubians), I have tended to follow a more cautious route, using MSM in conjunction with other kinds of markers, such as patterns of degenerative joint disease (osteoarthrosis) and joint facet extension. Also, my emphasis has been more on individual case studies in ancient and modern (forensic) contexts rather than large skeletal series. This presentation will examine MSM in historic context with emphasis on specific cases, particularly from the Canadian Arctic and northern Peru, where this kind of data has proven useful in reconstructing ancient patterns of behavior, especially when used in conjunction with other categories of markers. The use of MSM in solving Arizona homicide and missing persons cases, again in conjunction with other categories of markers, will also be examined.

Hawkey DE, Merbs CF. 1995. Activity-induced Musculoskeletal stress markers (MSM) and Subsistence strategy change among Ancient Hudson Bay Eskimos. *International Journal of Osteoarchaeology*, 5: 324-38.

Carrying loads and making shoes: skeletal markers of activity in a sample of porters and shoemakers from contemporary Italy

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Oral

Entheses, enthesopathies and articular features are usually studied in order to infer the type and levels of mechanical stress in ancient populations. However, it is well known that these osseous features have a multi-factorial etiology (age, sex, pathological conditions, etc.). For this reason, the study of identified modern skeletal collections (with known personal data) can aid in the interpretation of the characteristics observed. The aim of this study is to analyse osseous features possibly representing skeletal markers of activity in skeletons of individuals engaged in two different occupations. For this purpose we analysed a sample of 9 porters and 16 shoemakers from two identified Italian skeletal collections (Frassetto and Sperino collections which date from the end of 19th century and beginning of the 20th century). This study employs standardized scoring methods developed by our research group (Mariotti *et al.* 2004, 2007). The results highlight greater robusticity in the porters for all the functional complexes, in particular for the elbow (flexion-extension movements) and for the hip, consistent with the different kind of physical activity performed during life. This confirms the effectiveness of the features studied as markers of activity and the possibility of their use in the study of the lifestyle of past populations.

Key Words: skeletal markers of activity; identified skeletal collections; porters; shoemakers; standardised scoring methods

Mariotti V, Facchini F, Belcastro MG. 2004. Enthesopathies: proposal of a standardised scoring method and applications. *Collegium Antropologicum,* 28: 145-159.

Mariotti V, Facchini F, Belcastro MG. 2007. The Study of Entheses: proposal of a standardised scoring method for twenty-three entheses of the postcranial skeleton. *Collegium Antropologicum*, 31: 291-313.

Cross sections of radial tuberosity -geometrical properties, BMD distribution and effects of aging in MSM remodeling

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Oral

The aim of this research was to test new techniques to study muscle markers with intention to provide new information about the geometrical, biomechanical and densitometric properties of the MSM. Our research material consists of 117 skeletons derived from autopsies performed during the 1920s and 1930s and housed at the Central Natural History Museum, University of Helsinki. Age, sex, occupation and stature of these individuals are known. We applied a pQCT (peripheral quantitative computed tomography) scan (XCT-960A; Norland/Stratec, Fort Atkinson Pforzheim, USA/Germany) on the mid-site of the radial tuberosity to investigate the cross-sectional shape, bone distribution and bone mineral density (BMD) in the area. Our results indicate that remodelling does not result in increased wall thickness or BMD in this MSM area. Aging seems to have some effect on the biomechanics of the MSM area as bone distribution is affected by the reduced bone mass. This new method provides previously uncollected information on bone distribution at the radial tuberosity. The results of this study based on individuals of known sex, age, size and physical activities can be applied on archaeological material to aid in the reconstruction of past physical activity.

Key Words: radial tuberosity; pQCT; muscle markers; physical activity

Musculoskeletal markers in the Bronze Age population from Motilla del Azuer (Daimiel, Ciudad Real, Spain)

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Poster

The first aim of this study was to analyze 15 MSM in a sample of 34 individuals (25 males and 9 females) over 20 years old from the Bronze Age (2200-1400 BC) site of Motilla del Azuer (Daimiel, Spain) to obtain some information about activity patterns. This site is a fortified village situated in the La Mancha region. The surrounding terrain is a plain, but the village has many stairways in its architectural structure. The MSM studied were selected according to the procedures proposed in Al Oumaoui *et al.* (2004). Males have similar MSM development between the upper and lower extremities, while females show greater development in upper limbs, although this is generally lesser than in males. That could indicate a sexual division of activities, with the females working in domestic settings. These results were compared with those obtained from individuals of the El Argar culture (Bronze Age from the SE of Iberia) who lived in a rugged terrain. The only significant difference is in the marker of the femoral *linea aspera*. These results suggest that the lifestyle of the two populations is similar.

Key Words: Bronze Age; Iberian Peninsula; comparative study

Al Oumaoui I, Jiménez-Brobeil SA, du Souich Ph. 2004. Markers of activity patterns in some populations of the Iberian Peninsula. *International Journal of Osteoarchaeology,* 14: 343-359.

The scientific value of using a 3d surface scanner to quantify entheses

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Oral

The aim of our study was to test a new 3D method in using a surface scanner to quantify entheses. The results are compared to the ones obtained by visual scoring following the accepted standard method for recording entheses of Hawkey & Merbs on the same skeletons (1995). The skeletal remains selected for this investigation are very well preserved and come from the early medieval graveyard and settlement of Thunau/Gars, Lower Austria (9th/10th century A.D.) Although in the meantime the study of enthesopathies has become an important aspect in population based activity studies, due to enormous variability in size and shape of entheses, several problems remain that make meaningful inter-site comparisons difficult. Henderson and Gallant (2007) tried a promising 2D attempt to solve this, we try here to establish a new, three dimensional approach to quantify the surface structures of entheses and to upgrade the reproducibility. The fibrous enthesis of the M. pectoralis major on the right humeri of a sample of 21 individuals was surface scanned, covering the range from faint to strong expressions. The use of the Breuckmann Opto-Top HE optotopometric surface scanner (Breuckmann GmbH, Meersburg, Germany), resulted in models of the muscle insertions consisting of between 1.5 and 3 million points. By quantifying 3D/2D surface areas and perimeters, surface complexity measures and planarity statistics, the visual differentiation between the grades of entheses, scored with the standard method, could be confirmed. The results of this exploratory study could provide a basis for creating new standards for visual scoring of enthesis and joint features.

Key Words: entheses; 3D surface scanning; Medieval; Austria; applied study

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The morphology of clavicular entheses observed on a sample of identified skeletons (SIMON collection, Switzerland): methodological discussion

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Poster

The work presented here is part of a research project which aims to test the interpretative potential of different indicators skeletal adaptation to physical activity, including structural morphology of long bones, morphometry and entheses, in the SIMON collection (Switzerland) of identified skeletons (persons died during the first half of the 20th century). However, applying scoring methods that the literature suggests for entheses has caused us to confront major problems of replicability (inter-stage limits, variability of the expression of entheses). Thus, we have attempted to decrease the subjectivity of observations by adopting a sequential recording system. It consists of independently observing a series of criteria linked to the location, shape or elevation of the morphology pertaining to each enthesis and to formulate the description of these criteria in a way that systematically favours the testing of exclusive propositions. First, we obtain a series of encoded information (and not directly a given stage) which we submit to a statistical analysis which then allows us to proceed to the interpretation of the data. This recording system was applied to the insertions of the clavicles of a sample (86 females, 100 males) from the SIMON collection. The professions represented in this series allow us to explore the effects of physical activity by comparing people with no demanding daily physical activity (non or little-active) with active people, as well as craftsmen (specialists) and peasants ("generalists"). Preliminary results indicate the potential of this approach for the selection of morphological traits that carry useful information for the exploration of modifications that one can relate to functional adaptation.

Key Words: methodology; enthesis; clavicle; identified collection; physical activity

Interpreting patterns: A comparison of Near Eastern Neolithic MSM studies

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Oral

Ten years ago, Diane Hawkey and I edited a special issue of the *International Journal of Osteoarchaeology* dedicated to exploring the potential of MSM in activity reconstructions (Peterson and Hawkey 1998). In the following decade, research efforts have continued as studies emerge from a range of geographic, temporal, and methodological perspectives. The goal of this paper is to promote discussion about the productive use of MSM results in behavioral reconstructions. Two multi-site case studies that track activity changes and sexual labor patterns across the transition to agriculture in the Levant of southwest Asia are compared. My work looking at a sample of 106 skeletons from 13 sites suggests that sexual labor divisions become less pronounced during the Neolithic (c.10,200-6,000 b.p) compared to the earlier Natufian period (c. 12,500-10,200 b.p.) (Peterson 2002). Eshed *et al.* (2004), conversely, suggest that sexual labor patterns become more dichotomized during the Neolithic period (n=94 from 8 sites). I argue that *some* of the differences in study results make sense when viewed through a lens of local environmental and economic variation. Other differences are rooted, more deeply, in the assumptions authors make about the nature of men's work and women's work. Analysis of these interpretive discrepancies is relevant to the field as a whole, since MSM have emerged as a primary method in addressing sexual labor divisions. Future studies must be concerned not only with methodological refinements, but also with a more critical appreciation of the range of prehistoric sexual labor patterns.

Key Words: History of MSM; sexual division of labor; Levant of SW Asia; Natufian; Neolithic

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The costoclavicular ligament as an indicator of general workload: preliminary investigations

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Poster

Systematic studies regarding ligament attachments as markers of occupational stress (MOS) are still incipient in Brazilian bioarcheology. This preliminary study focuses on morphological alterations at the costoclavicular ligament insertion areas. This ligament plays an important role in shoulder and clavicle stabilization and is a relevant investigation site based on an emphasis on the use of the upper limbs among Brazilian coastal populations. A detailed study of this ligament is in progress investigating one of the biggest Brazilian shellmound skeletal collections - the Sambaqui de Cabeçuda, a large prehistoric site located in Santa Catarina State. Two distinct series were studied: the skeletons recovered between 2-3m deep and those recovered in a sector named "site 2". Ligament insertion area modifications were recorded using four categories: 1) no reaction; 2) smooth bone grown and roughness; 3) crest extensions accompanied by marginal delimitation; 4) large alterations (hypertrophy, deeply excavated attachment areas and lytic lesions). The analysis considered all individuals assigned as adults and later adolescents with at least one clavicle with the ligament insertion area preserved. A total of 32 individuals was studied (16 females, 15 males, 1 with unknown sex). In both series large alterations were observed only in males, although three individuals (two females and one male) with no hypertrophy presented signs compatible with lytic lesions. Size association is difficult to infer because of the fragmentary and incompleteness series condition, but massive alterations occurred in male individuals that exhibited greater bone robustness. Although other influence factors involved in costoclavicular ligament alterations, as hormonal influences, couldn't be proper evaluated, these preliminary results concur with previous MSM studies that suggested heavier upper limb loads in males and low impact of shoulder-related activities among females, such as swimming or paddling.

Key Words: costoclavicular ligament; Brazil; Brazilian shellmound; Sambaqui

The cost of lifestyle revisited: Musculoskeletal stress markers (MSM) in Brazilian prehistoric coastal populations. Methodological and interpretation challenges

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Oral

Musculoskeletal stress markers were systematically investigated in Brazilian prehistoric coastal populations since the latest years of 20th century. Most studied skeletal series presented a vigorous to moderate pattern of workload, dominance of bilateral activities and heavier workloads in males. A critical review of those studies is under development stressing the main challenges observed: methodological adjustments to small and fragmentary series, the difficulties to interpret skeletal markers in reconstruction of past activities and the complex interaction of MSM with other occupational stress markers. A comparative data reevaluation were made on four prehistoric coastal series from Rio de Janeiro State: Sambaqui da Beirada (4.520±190 to 3.800±190 BP[1]), Sambaqui do Moa (3.960±190 to 3.610±200 BP), Sambaqui Zé Espinho, (1.180±170 to 2.260±160 BP), Ilhote do Leste (3060±40 AP to 2650±350 BP); and one from Santa Catarina State: Praia da Tapera (1140±180 to 1030±180 BP). All those series were studied under the same methodological approaches considering occurrences of robusticity, stress lesions and ossifications, following Hawkey & Merbs[2] (1995). Although the first results confirmed the general pattern cited above, data reexaminations on Praia da Tapera series less ranked muscles, suggests that side differences were not completely obliterated by intense bilateral activities. The interaction with osteoarthrosis in some series was differential, suggesting that articular damage isn't directly linked to intensity of muscle insertion site development in some cases. The small series size is an unsolved challenge. The need to improve categorical standard in MSM evaluation was found crucial to avoid inter-observer bias. Those preliminary results reinforce investigations pathways still open after almost a decade of MSM studies in Brazil.

Keywords: Brazilian shellmounds; Sambaquis; Occupational Stress Markers; Applied study

[1]Uncalibrated dates.
[2]HAWKEY, D. E. & MERBS, C. F., 1995. Activity-induced musculoskeletal stress markers (MSM) and subsistence strategy among ancient Hudson Bay Eskimos. *International Journal of Osteoarchaeology*, 5: 324-338.

Musculoskeletal stress markers in Portuguese Late Neolithic population: What do they tell us?

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Poster

The aim of this work is the study of musculoskeletal stress markers (MSM) in seven skeletal samples uncovered from Late Neolithic Portuguese collective burials, representing a minimum number of 698 adult individuals. The human remains were recovered with no or almost no anatomical connection due to the burial practices, post-deposition activities and excavations with old methodologies. The analysis of MSM in upper and lower extremities was performed according to the methodology proposed by Crubézy (1988) and by individual bone. The more affected muscle/ligaments were the attachment of the quadriceps tendon (patella), affecting between 0% to 18.8% of bones and the Achilles tendon (calcaneum), with frequencies ranging from 0% to 66.75%. Statistical analysis was limited due frequently small and uneven sample sizes but the highest frequencies of MSM were scored in samples recovered from mountain regions. These observations could be linked to the greater mobility of these populations in daily movement and/or pastoral activities, also suggested by other morphological data including low femoral neck-shaft angle.

Key Words: Late Neolithic; Portugal; quadriceps tendon; Achilles tendon

Crubézy E. 1988. *Interactions entre facteurs bio-culturels, pathologie et caractères discrets. Exemple d'une population médiévale: Canac (Aveyron)*. Thèse de Doctorat, médecine, Université de Montpellier I, Montpellier, 417 p.

Can we derive occupation from enthesopathies? Lessons from the Coimbra Identified Skeletal Collection

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Oral

Theoretically, identified skeletal collections with reference to occupation are a major value for investigating occupational stress markers. To evaluate how useful these are to infer profession we carried out, in 1995, a research on the Coimbra Identified Skeletal Collection, dated from the early 20th century (Cunha and Umbelino, 1995). One hundred and fifty one skeletons, 76 males and 75 females with known occupation were analised in terms of enthesopathies, namely 31, according to the classification system proposed by Crubézy (1988). Our findings seem to support the statement that the role of occupational stress as a factor in enthesopathies is far from being unequivocal. Furthermore, we argue that the main problem is due to the lack of definition of the occupations, for both sexes, which can, in many instances, include a large variety of physical efforts and the impossibility to know for how long the concerned individuals practiced the referred occupations. The methodology applied (Crubézy, 1988) as also the problem of only considering proliferative lesions, which the formation of osteophytes.

Key words: Enthesopathies, occupation, 19th-20th century, applied study, Portugal

Crubézy, E. 1988. *Interactions entre facteurs bio-culturels, pathologie et caractères discrets. Example d'une population medieval: Chanac (Aveyron)*. Thèse de Doctorat. Montepellier, Université de Montpellier.

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Enthesopathies as occupational stress markers:
A reliable and reproducible method based on present medical data

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Oral

In bioarchaeology, enthesopathies i.e. "musculoskeletal stress markers" are assumed to reflect the activity of the attaching musculature, even though studies of enthesopathies using known occupation skeletal samples (Cunha and Umbelino, 1995; Mariotti *et al.*, 2004, 2007) failed to find differences between activity groups. Moreover, the lack of standardised observation methods limits the comparison between different studies and the distinction between healthy and pathological aspects has been arbitrary in many works. I have proposed earlier (2006) a method of studying enthesopathies based on present medical data. This reproducible (intra- and inter-observer errors < 10%) method consists of four scoring systems. This paper presents results of an application of these scoring systems on a reference sample (from Coimbra, Spitalfields, Sassari and Bologne) of known age at death, sex and activity (n = 721, 248 females and 473 males). The analysis has established a strong link between enthesopathies and physical activity for the first scoring system (nine fibrocartilaginous entheses, upper and lower limbs). Other factors, such as age, also play an important role. On the other hand, there is no clear correlation between osseous modifications and occupation groups for the other scoring systems, notably the one which concerns fibrous entheses (e.g.: deltoid or pectoralis major insertion). According to these results, it appears that enthesopathies can be used to reconstruct past lifestyles of populations if physical anthropologists 1) pay attention to the choice of entheses in their studies 2) use appropriate methods for studying bony lesions.

Key Words: methodology; identified collection; fibrocartilaginous entheses; fibrous entheses; enthesopathies

Cunha E, Umbelino C. 1995. 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). *Antropologia Portuguesa,* 13: 49-68.

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New directions in the analysis of Musculoskeletal Stress Markers

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Oral

Most studies of musculoskeletal stress markers (MSMs) utilize ordinal scales of enthesial expression, which limits control for factors such as age, sexual dimorphism, and body-size scaling. This study assesses alternative, quantified MSM data collection methods, and evaluates their potential for exploring the contributions of environmental and biological variables to enthesial variation. The first method analyzed size-standardized 2-D surface areas of seven muscle insertion areas of the upper limb (137 American Blacks and Whites, and 238 Native American samples from Hawikuh, New Mexico; Indian Knoll and Hardin Village, Kentucky; Kushkokwim River, Point Barrow and Mummy Cave, Alaska). In principle components analysis, the first three components accounted for 78.4% of the insertion area variance and separated the sample by sex and geographic region rather than subsistence patterns. An inverse correlation between the insertion areas and published data on bone mineral density in several related populations, suggests scaling to maintain a constant level of muscle strain per unit volume of bone independent of differences in the relative intensity of daily activities. However, the 2-D method fails to incorporate surface relief differences, which are a major feature in most ordinal scoring systems. Initial 3-D quantification of the biceps brachii insertion was performed on 30 white males from the Terry collection, Smithsonian Institution. The 3-D surface areas and volumes of this attachment show a higher correlation with body size than 2-D areas ($r^2 = 0.49$ vs. $r^2 = 0.68$) and greater right-side size bias, suggesting 3-D data is a promising methodological approach to assess enthesial variation that may be induced by habitual activity while controlling for extraneous factors.

Key Words: methodologies; sexual dimorphism; body size standardization;
3-D quantification

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