

Morphological Analysis of the Proximal Femur Using CT Images

K. Magalhães¹, E.M.M. Fonseca¹, L.M.S. Barreira¹

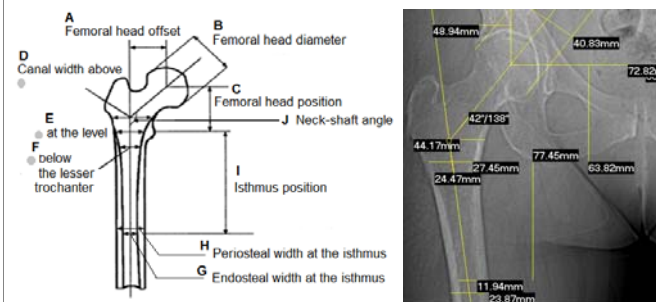
¹IPB - Instituto Politécnico de Bragança, Escola Superior de Tecnologia e Gestão, Portugal

1. Introduction

- The main objective of this work is to evaluate the femur morphology in women, through a digital methodology using Computed Tomography or medical images.
- Because of the great variation of femur anatomy there are few detailed studies of the geometry and the femur morphology, needed to the best bone-implant fit to a patient.
- Recently, studies propose different techniques to be used for the design of the human femur geometry and present some results from a group of populations.

2. Materials and Methods

- The sample comprises six women recruited in a Medical Imaging Centre of Radiology, in Porto, with age between 37 and 56 years. The patients underwent a proximal femoral Computed Tomography scan (*Lightspeed Plus, GE Medical System*).
- Different anatomical characteristics were measured on the anteroposterior CT, including the femoral head offset (A); the femoral head diameter (B); the femoral head position (C); canal above (D), at the level (E) and above (F) the lesser trochanter; endosteal (G) and periosteal (H) width at the isthmus; isthmus position (I) and neck-shaft angle (J).



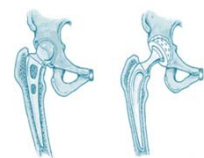
3. Results and Discussion

- Discussion of results regarding the measuring of the bone geometry, for both left and right femur, were obtained using a radiology reading software (iQ-View).
- The measurements were then submitted to arithmetic average (X), standard deviation (SD), and medium (Me).
- The X values in mm found for the right and left femur respectively were: A (43,0 / 42,6); B (42,8 / 39,6); C (55,3 / 57,6); D (40,6 / 39,0); E (23,6 / 23,8); F (18,0 / 19,8); G (10,6 / 11,2); H (23,9 / 24,4); I (65,9 / 66,7); J (139,0 / 142,5).
- Recorded parameters are compared with other studies:

	Present Study	Umer et al.	Rubin et al	Massin et al
Sample	6	136	32	200
A (mm)	42,83	41,90	47,00	41,00
B (mm)	41,19	50,10	43,40	45,60
C (mm)	56,47	56,00	56,10	58,70
D (mm)	39,82	47,40	43,10	-
E (mm)	23,69	28,30	27,90	26,50
F (mm)	18,88	21,10	21,00	19,60
G (mm)	10,89	11,00	13,10	12,40
H (mm)	24,13	27,90	26,70	27,60
I (mm)	66,29	106,70	105,70	-
J (°)	140,75	130,30	122,90	123,10

4. Conclusions

- Based on the measurements, it could observe that the femur morphology is altered by age, and small differences between the left and right femur were registered.
- The neck-shaft angle is greater in younger patients, decreasing with increasing patient age.
- For neck-shaft angle: normal value (between 125-140°); thigh valga (>140°); coxa vara (<125°).
- The recorded parameters are similar with other studies, regardless of the sample size (Asia and Europe).
- The goal of this study is to acquire accurate values, concerning the morphology of the proximal femur, which could be used as a parameter to allow a femoral implant design, and it could be used to the clinical practice.



5. References

- Yongtae Jun, Kuiwoon Choi, Design of patient-specific hip implants based on the 3D geometry of the human femur, *Advances in Engineering Software*, 41, 537-547, 2010.
- Masood Umer et al, Morphology of the proximal femur in a Pakistani population, *Journal of Orthopaedic Surgery*, 18 (3), 279-81, 2010.
- P J Rubin et al, The morphology of the proximal femur - a three-dimensional radiographic analysis, *Journal of Bone and Joint Surgery*, 74-B (1), 28-32, 1992.
- Phillipe Massin et al, The Anatomic Basis for the Concept of Lateralized Femoral Stems, *Journal of Arthroplasty*, 15 (1), 93-101, 2000.

Acknowledgements to the institutions that made possible this work:

MEETING ON EPIDEMIOLOGY OF HIP FRACTURES

16-17 DECEMBER 2013

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[MORE INFORMATION: RITA.MATOS@IBMC.UP.PT](mailto:RITA.MATOS@IBMC.UP.PT)



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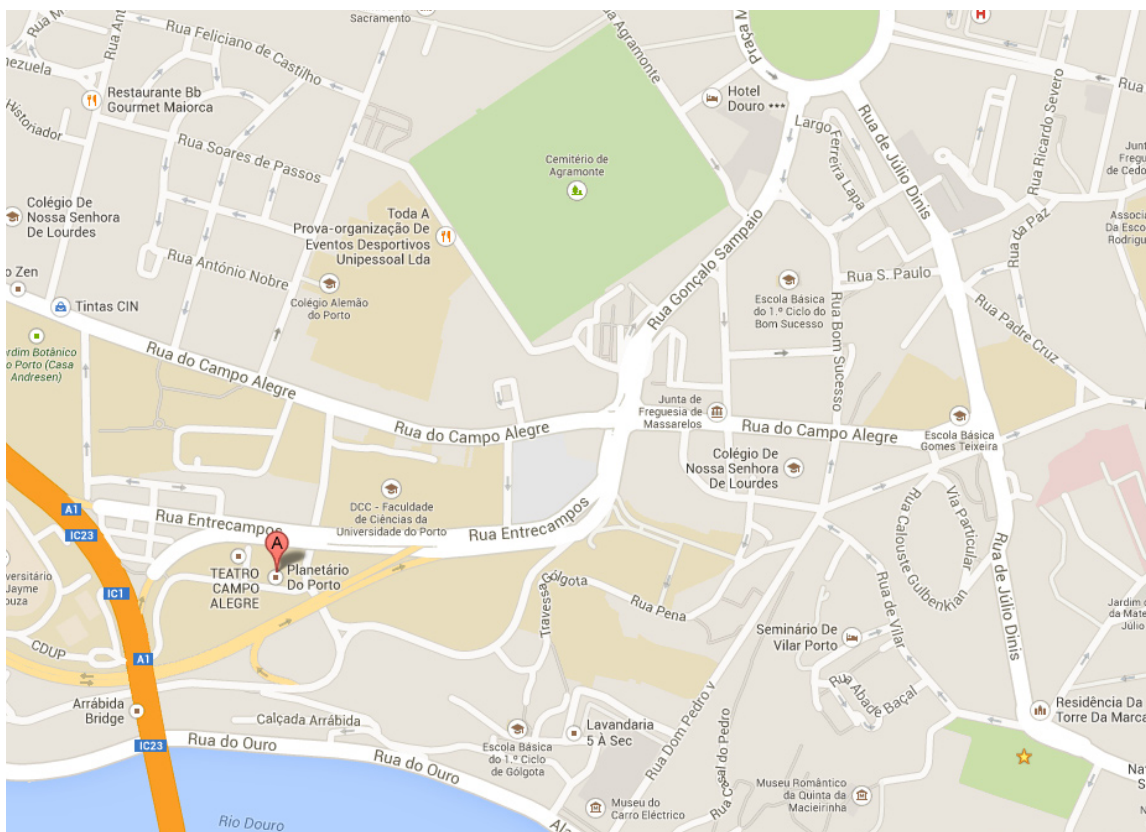
CENTRO DE ASTROFÍSICA DA UNIVERSIDADE DO PORTO | PORTO | PORTUGAL

VENUE



MEETING: Centro de Astrofísica da Universidade do Porto (CAUP)

Rua das Estrelas, 4150-762 Porto



MEETING ON EPIDEMIOLOGY OF HIP FRACTURES

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SOCIAL PROGRAMME

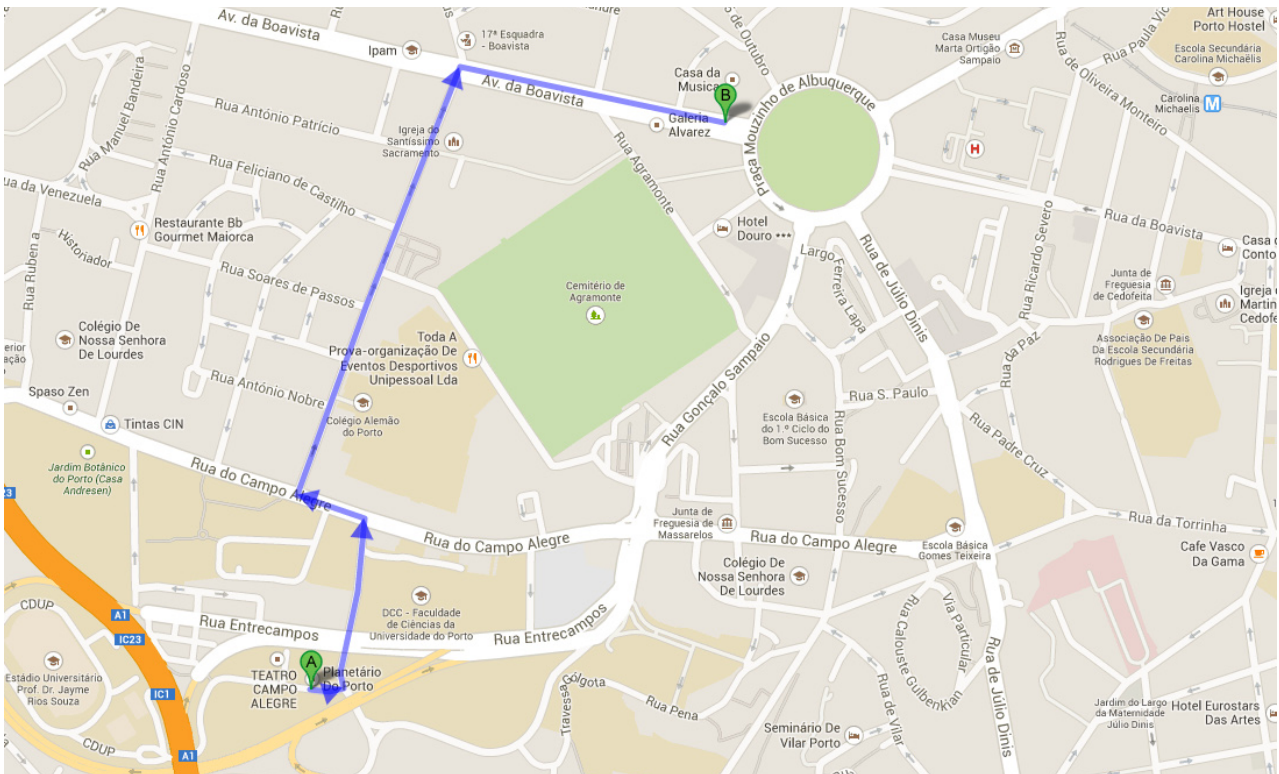
16 December | 19:00 | Visit to Casa da Música

16 December | 20:00 | Dinner at Casa da Música



CASA DA MUSICA

Avenida da Boavista, 604; 4149-071 Porto



MEETING ON
EPIDEMIOLOGY OF HIP FRACTURES

CENTRO DE ASTROFÍSICA DA UNIVERSIDADE DO PORTO | PORTO | PORTUGAL

PROGRAMME | 16 DECEMBER 2013

09:00–09:10 OPENING REMARKS

Objectives of the project bone decade in Portugal, spatio-temporal trends in the incidence of hip fractures
Maria de Fátima de Pina, FMUP / INEB / ISPUP, Porto, Portugal

09:10–09:30 RESULTS I

In-hospital fatality following hip fracture care
Sandra Alves, INEB / ESTSP/ ISPUP, Porto, Portugal

09:30–09:50 RESULTS II

Survival after a Proximal Femur Fracture: 252 patients followed during one-year after the fracture
Sónia Campos, INEB/ ISPUP, Porto, Portugal

09:50–10:30 COFFEE BREAK AND POSTER SESSION

10:30–11:15 HEALTH AND SOCIETY

Hip fractures: challenges on orthopaedic departments and health systems
Enrique Gómez-Barrena, Universidad Autónoma de Madrid, Spain

11:15–12:00 METHODOLOGY

Secondary data: strengths and limitations for epidemiological studies
Marília Carvalho, Oswaldo Cruz Foundation, Health Ministry of Brazil, Rio de Janeiro, Brazil

12:00–12:20 RESULTS III

Bisphosphonates sales and observed turning point in trend. A population-based retrospective study
Sandra Alves, INEB / ESTSP/ ISPUP, Porto, Portugal

12:20–14:00 LUNCH

14:00–14:45 HEALTH AND SOCIETY

Relevance of the Neuro-skeletal network in bone remodeling
Meriem Lamghari, Instituto de Engenharia Biomédica - INEB, NEWTherapies Group, Porto, Portugal

14:45–15:05 RESULTS IV

Does the incidence of hip fractures vary by regional socioeconomic status?
Carla Oliveira, INEB / ISPUP, Porto, Portugal

15:05–15:50 METHODOLOGY

Modern statistical methods in ecological studies
Theodoros Economu and Trevor Bailey, College of Engineering, Mathematics and Physical Sciences, University of Exeter, UK

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15:50–16:10 RESULTS V

Age-period-cohort effects in the incidence of hip fractures: political and economic events coincident with changes in risk

Maria de Fátima de Pina, FMUP / INEB / ISPUP, Porto, Portugal

16:10–16:30 COFFEE BREAK

19:00 VISIT TO CASA DA MUSICA & DINNER

PROGRAMME | 17 DECEMBER 2013

09:00–09:45 HEALTH AND SOCIETY

Trends in the burden of hip fractures - what does the past tell us?

Kevin L. Ong, Exponent, Philadelphia, USA

09:45–10:30 METHODOLOGY

Data access and data quality

Claúdia Medeiros Borges, Health Services Department, Central Administration of Health Services (ACSS), Lisboa, Portugal

10:30–11:00 COFFEE BREAK

11:00– 11:45 METHODOLOGY

The National Hospital Discharge Database

Fernando Lopes, FMUP, Porto, Portugal

11:45–12:30 METHODOLOGY

Uncovering the location of Twitter users: a tool for monitor real-time health events

Renato Assunção, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

12:15–14:00 GROUP PHOTO AND LUNCH

14:00–15:30 ROUND TABLE: PREVENTION OF HIP FRACTURES

Life course approach to bone health

Prevention measures in the health system

Health UP - campaign for falls prevention

Raquel Lucas, ISPUP, Porto, Portugal

Henrique Botelho, Unidade de Saúde Familiar Manuel Rocha Peixoto, Braga, Portugal

Júlio Borlido, IBMC.INEB, Porto, Portugal

15:30–15:45 CLOSING SESSION

Maria de Fátima de Pina, FMUP / INEB / ISPUP, Porto, Portugal

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INFORMATIONS

REGISTRATION DESK

The Registration Desk will open at 8:30 on 16–17 December 2013.

NAME BADGES

For identification and security purposes, participants must wear their name badges when in the venue. The use of the badge is mandatory for the access to coffee breaks.

PRESENTATION INSTRUCTIONS

Speakers presenting in the morning should hand in their presentations in the auditorium until 9:00 of the presentation day.

Speakers presenting in the afternoon sessions, should hand in their presentations during lunch break.

A data-show and PC will be at the presenters' disposal. Technicians will be available to make sure that you have successfully submitted your presentation. You will be requested to provide your presentation on a USB key.

POSTER PRESENTATION

Poster should have 1,20 m (height) x 0,90 m (width) and will be presented on the designated poster area. Meeting staff will be present to provide assistance.

INTERNET ACCESS

Wireless internet is freely available in the meeting venue.

COFFEE BREAKS

Coffee breaks will be served next to the auditorium.

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INVITED SPEAKERS



MARILIA SÁ CARVALHO

OSWALDO CRUZ FOUNDATION, HEALTH MINISTRY OF BRAZIL, RIO DE JANEIRO, BRAZIL

Marília Sá Carvalho is a senior researcher at Fundação Oswaldo Cruz (Rio de Janeiro, Brazil), Editor-in-Chief of *Cadernos de Saúde Pública* and associate editor of *PLOS Neglected Tropical Diseases*. Marília graduated in Medicine at the Universidade Federal do Rio de Janeiro in 1979. In 1990 she had completed her PhD in Biomedical Engineering at the same institution. Her research interests span a wide range of topics from environmental epidemiology (spatio-temporal analysis) to survival analysis.



TREVOR BAILEY

COLLEGE OF ENGINEERING, MATHEMATICS AND PHYSICAL SCIENCES, UNIVERSITY OF EXETER, UK

Trevor Bailey joined the University of Exeter in the late 1980's from the Australian Graduate School of Management, University of New South Wales, Australia. His research interests are in spatial statistics (particularly: spatial epidemiology, spatial modelling, multivariate spatial methods) and also in applied statistical modelling more generally. Much of his research has been collaborative involving academics and professionals from a variety of different fields including health care, geography, computer science, behavioural science, commercial organizations and government agencies. He is a Fellow of the Royal Statistical Society and of the Higher Education Academy and a Chartered Statistician.



THEODOROS ECONOMOU

COLLEGE OF ENGINEERING, MATHEMATICS AND PHYSICAL SCIENCES, UNIVERSITY OF EXETER, UK

Theodoros Economou is a research fellow at the University of Exeter. Currently he is investigating extreme extra-tropical cyclones and the dependencies of their associated perils. His research interests are applied statistical modelling, epidemiology, spatio-temporal extreme value modelling and in hidden semi-Markov models and their applications. His research includes work on health related studies (e.g., infectious disease modelling), on water engineering (e.g., underground water pipe breakage) and meteorology (e.g., predicting hail events in central Europe).



ENRIQUE GÓMEZ-BARRENA

UNIVERSIDAD AUTÓNOMA DE MADRID, SPAIN

Enrique Gómez-Barrena is full Professor and Chair of orthopaedic surgery, Universidad Autónoma de Madrid, Spain, and Attending Orthopaedic Surgeon at La Paz Hospital in Madrid. His medical degree (1987) is from the University of Zaragoza and the PhD (1992) is from the Universidad Autónoma de Madrid, Spain.

He is a reference in orthopedic surgery and since 2010 holds the position of associate chief in orthopaedic surgery at La Paz Hospital, Madrid. Professor of Orthopaedic Surgery at the Universidad Autónoma de Madrid, since 2000, full professor since 2010 and vice-dean of the Universidad Autónoma de Madrid Medical School from 2004 to 2011.

Enrique Gómez-Barrena is member of the most influential organizations in the field of orthopedics, and he is currently the President of EORS, the European Orthopaedic Research Society, and Member of the Executive Committee of EFORT, the European Federation of Orthopaedics and Traumatology Societies.

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KEVIN L. ONG

EXPONENT, PHILADELPHIA, USA

Dr. Kevin L. Ong is a Senior Managing Engineer in Exponent's Biomedical Engineering practice. Dr. Ong's area of expertise is product design evaluation and failure analysis of medical devices, with a focus on evaluating how patient, surgical, and design factors influence performance. He also has expertise in nonlinear finite element analysis, solid mechanics, and orthopaedic biomechanics. He has experience with orthopaedic, spine, fracture fixation, cardiovascular, and diagnostic medical devices from product liability, intellectual property, regulatory (FDA) compliance, product development, epidemiology, health economics, and technology assessment perspectives. Dr. Ong has directed preclinical and postmarket mechanical testing experiments of bone and soft tissue to evaluate and characterize biomaterials and medical devices, including wear testing and retrieval (explant) analysis. He has designed experiments for standard tests (e.g., ASTM, ISO), as well as developed non-standard or novel testing protocols. His research interests include investigating the failure mechanisms of implantable devices, as well as evaluating the efficacy of novel medical devices. He has also evaluated the interaction between medical devices and injury tolerances/patterns. Dr. Ong has been involved in biomechanics and biomedical engineering research since 1997. He is also presently holding a research faculty appointment at the School of Biomedical Engineering, Science and Health Systems at Drexel University. Prior to joining Exponent, Dr. Ong was a research assistant in the Department of Mechanical and Aerospace Engineering at Cornell University, in the Cornell University-Hospital for Special Surgery Program in Biomedical Mechanics.



MERIEM LAMGHARI

INSTITUTO DE ENGENHARIA BIOMÉDICA - INEB, NEWTHERAPIES GROUP, PORTO, PORTUGAL

Meriem Lamghari is an investigator at INEB (University Porto) and team leader of the Neuro-osteogenesis team from the NEWTherapies Group. Her team wants to understand the role of the brain and sympathetic nervous system on bone remodeling and repair. Her main research interests are focused on the involvement of the nervous system namely Neuropeptide Y (NPY) neuronal pathway in bone regeneration and develop therapeutic applications based on NPY receptors drugs target for bone repair. Lamghari has received her PhD in bone regeneration with the thesis "Evaluation de l'effet ostéogénique de la nacre en site vertébral" by the Jussieu Paris VII University - France in 1999, and has conducted her post-doctoral research at IBMC/INEB Associate Laboratory. She was also a visiting scientist at Garvan Institute of Medical Research in Sydney and Auxiliary Invited Professor in Lecturer of Biological Reactions to Biomaterials and Medical devices and Lecturer of Molecular and Cell Biology at Faculty of Engineering of Porto University- FEUP.



FERNANDO LOPES

FACULDADE DE MEDICINA DA UNIVERSIDADE DO PORTO, PORTO, PORTUGAL

Fernando Lopes is a medical doctor, responsible for the area of support for teaching and scientific research in the Medical School of Porto University, the same institution where he got the degree in Medicine. He is member of the Technical Committee of the Clinical Coding and responsible for the creation and development of an information system for the surgery department and the Office of Management Analysis (coding, process control, statistical and billing) of Hospital of São João.

Fernando Lopes developed the Auditor's software used in the National Health System and the web portal Clinic Codification and Diagnosis Related Groups. He is also President of the Physicians' Clinical Coders and Auditors Association and consultant, external auditor and trainer of coding and Diagnosis Related Groups in the Braga Hospital, the Institute of Oncology - Porto, the Central Administration of Health System and in the Regional Administration of Health - north region.

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CLÁUDIA MEDEIROS BORGES

HEALTH SERVICES MANAGEMENT DEPARTMENT, CENTRAL ADMINISTRATION OF HEALTH SERVICES (ACSS), LISBOA, PORTUGAL

Cláudia Medeiros Borges is a Sociologist with a post graduation in hospital management. She has worked in hospitals as a logistics manager prior to joining the Health System Central Administration in 2003. Presently, Cláudia Medeiros Borges is the coordinator for the Patient Classification Systems (PCS) area at the Health Services Management Department in ACSS. Within her duties, she has the responsibility to coordinate the development and maintenance of the DRG National System, including the adoption of new DRG groupers and corresponding price list. Along with the management of the DRG central database and its use for centrally calculated indicators, she has been responsible for the functional progress of the hospitals tool used to collect the necessary minimum data (administrative and clinical) set. She has also led studies for the use of risk adjustment tools and its employment in financing models as well as studies for new PCS for long term and rehabilitation care, including the development of a new PCS for ambulatory rehabilitation, to be implemented in primary care units.

Cláudia Medeiros Borges is a member of the Health Statistics Work Group at the Statistics Superior Council. She is also a member of the Health and Incapacity Terminology Taskforce at the National Statistics Institute and of the National Commission for ICD9CM coding. She participates at the National Work Group for Primary Care Morbidity Registry and is a member of the national team for the implementation of the ICD10CM/PCS coding system in 2016. She was member of the National Commission for Ambulatory Surgery Development and has participated in several hospital cost accounting projects.



RENATO ASSUNÇÃO

UNIVERSIDADE FEDERAL DE MINAS GERAIS, BELO HORIZONTE, BRASIL

Renato Assunção is Professor in the Department of Computer Science, Universidade Federal de Minas Gerais (UFMG) located in Belo Horizonte, Brazil, since September 2011. He received his Ph.D. in Statistics in 1994 from the University of Washington, Seattle, USA, having Peter Guttorp as advisor. From 1994 to 2011, he worked in the Department of Statistics, UFMG. His current research is focused on the development of new algorithms and statistical methods to analyze spatial and space-time data. He is primarily concerned with the spatial analysis of risk appearing in many fields such as epidemiological surveillance, geosensor networks, environmental problems, spatially variable risk, among many others. The computer revolution, still going on, has made it possible to manage huge space-time databases. The extraction of interesting patterns from these massive databases create new, challenging, and interesting problems that require creative algorithmic, statistical and probabilistic solutions and this has been his main research areas.

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POSTERS LIST

POSTER 01

Morphological Analysis of the Proximal Femur Using CT Images

K. Magalhães, E.M.M. Fonseca, L.M.S. Barreira

POSTER 02

Effects of temperature and precipitation on spatial-temporal variations of hip fracture in Portugal

Carla Oliveira, TheodorosEconomou, Trevor Bailey, Maria Fátima Pina

POSTER 03

Effectiveness on posture of a specific spinal exercise program for falls prevention in elderly

C. Crasto, C. Melo, A. Montes, R. Santos, N. Carvalho, I. Tarrío, A. Gomes, C. Cela, T. Sousa

POSTER 04

The influence of a moderate specific thoracic spine exercise program on thoracic erector spinae activity and strength in Portuguese old people

C. Melo, N. Carvalho, A. Montes, C. Crasto, M. Santos, R. Santos, I. Tarrío, A. Gomes, C. Cela, T. Sousa

POSTER 05

Effect of a specific balance exercise program in old Portuguese people

C. Melo, A. Gomes, A. Montes, C. Crasto, R. Santos, I. Tarrío, N. Carvalho, C. Cela, T. Sousa

POSTER 06

Spatial and temporal evolution of hip arthroplasties and revision, from 2000 to 2008 in Portugal

C Santos, MF de Pina

POSTER 07

A FRAX model for the estimation of osteoporotic fracture probability in Portugal

Marques A., Mota A., Canhão H., Romeu JC., Machado P., Ruano A., Barbosa AP., Dias AA., Silva D., Araújo D., Simões E., Águas F., Rosendo I., Silva I., Crespo J., Alves JD., Costa L., Mascarenhas M., Lourenço O., Ferreira PL., Lucas R., Roque R., Branco J., Tavares V., Johansson H., Kanis J., Da Silva JPA.

POSTER 08

Nursing interventions to prevent falls in older people: a systematic review of randomized controlled trials

I.Lage, O.Araújo, S.Vilaça

POSTER 09

How we are treating osteoporotic hip fractures (OHF)? A nationwide observational study in Portugal

C. Alves, S. M. Alves, M.F. Pina

POSTER 10

Identifying sensitive periods for the effects of adiposity and glucose metabolism on pediatric bone: a birth cohort approach

T. Monjardino, R. Lucas, T. Rodrigues, Henrique Barros

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POSTER 11

Incidente of proximal femur fracture: a longitudinal study in a main portuguese hospital

Sonia Campos, Abel Trigo Cabral, Maria Fátima Pina

POSTER 12

Proximal femur fractures prevention in the elder: A proposal for intervention in falls risk reduction

D.C. Luzio, M.F. Pina

POSTER 13

BMD assessment in primary health care through QUS

LP Ribeiro, A Abrantes, JP Pinheiro, F Jesus, RP Almeida, KB Azevedo, A Ribeiro

POSTER 14

Bibliographic review on falls prevention actions

Clarisse Resende, Ana Paula Rocha, Maria Eduarda Silva, Maria de Fátima de Pina
