

# The international Foot and Ankle Biomechanics community

## 1<sup>st</sup> i-FAB Congress

4-6 September 2008

*Centro di Ricerca Codivilla-Putti  
Istituto Ortopedico Rizzoli,  
[IOR Research Centre]  
Bologna, Italy*



*Congress Chair  
Dr Alberto Leardini*

# Programme schedule

# Thursday, 4<sup>th</sup> September 2008

8.00 – 17.30 Registrations, IOR Research Centre

## Tutorials:

7.30 A- Total ankle replacement, operation live by prof. Sandro Giannini; video-audio connection in Aula Campanacci, IOR hospital

9.00 B- Anatomy of the Foot and Ankle, dissection live (Giovanni Mazzotti, Fabio Catani); Movement Analysis Laboratory, Sala del Federalismo, IOR Research Centre

11.00 C1- Biomechanics of the Developing Human Foot (Sorin Siegler); Auditorium, IOR Research Centre

11.00 C2- Multi-segment Foot Kinematics In-vivo: hands-on (Maria Grazia Benedetti, Ilse Jonkers, Julie Stebbins, Sebastian Wolf) - Movement Analysis Laboratory, IOR Research Centre

**12.00 Welcome reception** Bar/Caffetteria, IOR Research Centre

**13.00 – 13.30 Opening** Auditorium, IOR Research Centre

## 13.30 – 14.00 Key Lecture 1

*Harold Kitaoka* (Department of Orthopedics, Mayo Clinic, USA): Advances in biomechanics of posterior tibial tendon dysfunction and flatfoot deformity

## 14.00 – 15.30 Oral Session 1, Pathological Foot

*Chairmen: Sandro Giannini and Martinus Richter*

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|----|-----------|--|
| O1 | Chang R   | Energetics of the intrinsic foot muscles in plantar fasciitis  |
| O2 | Ledoux WR | Clawed toes in the diabetic foot: neuropathy, intrinsic muscle volume, and plantar aponeurosis thickness |
| O3 | Sawacha Z | The role of shear stress in the aetiology of diabetic neuropathic foot ulcers                            |
| O4 | Rao S     | Plantar fascia thickness and first metatarsal mobility in patients with diabetes and neuropathy          |

- O5 Burns J Evolution of foot manifestations in children with Charcot-Marie-Tooth disease
- O6 Nawoczinski DA Comparison of the clinical Heel Rise test in subjects with Stage II PTTD and healthy controls
- O7 Delahunt E The effects of taping and exercise on ankle joint movement in subjects with functional instability of the ankle joint during a jump down

**15.30 – 16.45 Coffee Break & Poster Session 1**

*Chairmen: William Ledoux and Debbie Nawoczinski*

- P1 Hennig E Foot pain and body weight - results from 4000 german children - part of an international study on foot function and childhood obesity
- P2 Forghany S The effects of stroke on foot kinematics
- P3 Giacomozzi C Biomechanics of the diabetic neuropathic foot: altered GRF during propulsion
- P4 Hsu HC Biomechanical analysis of landing patterns in subjects with recurrent lateral ankle sprains
- P5 Romkes J Foot characteristics and body weight - a study of 1038 Swiss children: part of an International Study on Foot Function and Childhood Obesity
- P6 Wegener C Effect of custom orthoses on foot pain and plantar pressure in people with diabetes mellitus and peripheral arterial disease
- P7 Mauch M Foot discomfort in 6-14-year-old normal and overweight children
- P8 Rao S Comparison of in-vivo segmental foot mobility during walking and step descent in patients with midfoot arthritis
- P9 Sawacha Z Type of foot contribution in the biomechanics of the diabetic foot
- P10 de David AC Gait parameters in children with flexible flat foot
- P11 Nawoczinski DA Clinical predictors of forefoot dorsiflexion during a bilateral heel rise task in subjects with Stage II posterior tibial tendon dysfunction
- P12 Begg L Offloading the diabetic foot ulcer: comparison of total contact casting techniques

- P13 Simonsen O Increased foot pronation among 16 to 18 year old high-school students with patellofemoral pain syndrome
- P14 Ursino S Correlation between surface EMG and kinematics-kinetics-plantar pressure analysis of diabetic neuropathic foot
- P15 Matricali GA Rigid hallux valgus correction to reduce detrimental plantar pressures causing a recurrent malum perforans
- P16 Lu TW Dynamic foot pressure in patients with hallux valgus during stair climbing
- P17 Riganti S Late presentation of foot deformities in totally involved Cerebral Palsy patients
- P19 Wetz HH Reconstructive foot surgery in Charcot arthropathy
- P20 Ingrosso S Gait analysis of a novel design of ankle replacement
- P21 Puchmeltrova M Retrospective evaluation of the hallux metatarsophalangeal joint replacement
- P22 Richter M Reconstructive foot and/or ankle surgery improves preoperative pathologic pedographic findings at 3-months-follow-up
- P23 Balestri M Tibial remodelling after fibula harvesting: an in-vivo quantitative estimation
- P24 de David AC Effects of ankle cryotherapy in postural stability
- P25 Delahunt E An investigation into the effects of ankle taping on lower limb joint angular displacements and ground reaction forces during a single leg drop landing in healthy male subjects

**16.45 – 17.15 Key Lecture 2**

*George Arangio* (Department of Orthopedics, M.S. Hershey Medical College, USA): Sailing charted seas: biomechanics and the orthopedic surgeon

**17.15 – 18.20 Oral Session 2, Foot and Ankle Surgery**

*Chairmen: Peter Cavanagh and George Arangio*

- O8 O'Connor JJ Preliminary results of a biomechanics driven design of a total ankle prosthesis
- O9 Matricali GA Pressure profile changes after cartilage biopsy at the postero-medial rim of the talar dome

- O10 Richter M      Robotic cadaver testing of a new total ankle prosthesis model  
(German Ankle System)
- O11 Kuo CC        Ankle morphometry in Chinese population
- O12 Nawoczinski DA    In-vivo first metatarsophalangeal joint mechanics following  
Cheilectomy: MRI and gait alterations

**18.20 – 19.00 Web-services demonstration**

# Friday, 5<sup>th</sup> September 2008

## 7.30 – 12.30 Registrations

## 8.00 – 8.30 Key Lecture 3

*Mario Lafortune* (Nike Sport Research Laboratory, USA): The role of research in the development of athletic footwear

## 8.30 – 10.00 Oral Session 3, Shoes, Sport & Performance

*Chairmen: Sebastian Wolf and Chris Nester*

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|-----|----------------|--|
| O13 | Hagen M        | Effects of different shoe lacing patterns on perceptual variables and dorsal pressure distribution in heel-toe running       |
| O14 | Baur H         | Therapeutic efficiency and biomechanical effects of sport insoles in female runners  |
| O15 | Davis IS       | Rearfoot and knee coupling over a prolonged run in runners with patellofemoral pain syndrome                                 |
| O16 | Heidenfelder J | Heel strike angle and foot angular velocity in the sagittal plane during running in different shoe conditions                |
| O17 | Castro MA      | Biomechanical analysis of an inciting event of ankle sprain on basketball players  |
| O18 | Deleu PA       | Impact of 90 minutes running exercise on plantar loading of the forefoot: a prospective study on symptom-free athletes       |
| O19 | Zhang S        | Efficacy of an ankle orthosis with a subtalar locking system in restricting ankle kinetics and kinematics in lateral cutting |

## 10.00 – 10.30 Coffee Break & Poster Session 2

*Chairmen: Ewald Hennig and Thorsten Sterzing*

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|-----|------------------|--|
| P26 | Gapeyeva H       | Muscle tone, elasticity and stiffness of calf muscles in young ballerinas with overload of foot and ankle joint        |
| P27 | Sterzing T       | Bridge modifications of running shoe heel area influence rearfoot motion parameters                                    |
| P28 | Hagen M          | Identification of angle-dependent dorsiflexor strength development for optimization of a variable-cam training machine |
| P29 | Shariatmadari MR | Performance of EVA footwear foam under dynamic compressive   |

loading

- P30 Fukano M Foot arch kinematics of barefoot and shod landing
- P32 Dedieu P Changes in ankle kinematics during walking/running with or without swinging arms
- P33 Ozyurek S The assessment of ankle strategy in professional dancers

#### 10.30 – 11.00 Key Lecture 4

*Peter Cavanagh* (Department of Biomedical Engineering, Cleveland Clinic, USA):  
Biomechanical factors in diabetic foot disease

#### 11.00 – 12.20 Oral Session 4, Pedography

*Chairmen: Joshua Burns and Dieter Rosenbaum*

- O20 Bosch K From “first” to “last” steps in life – pressure patterns of three generations
- O21 Edwards WB Foot joint pressures during dynamic gait simulation
- O22 Stebbins J Correlation between plantar pressure and Oxford Foot Model kinematics
- O23 Orendurff M Metatarsal fracture mechanism: accelerating loads the fifth ray more than cutting
- O24 Richter M Pedographic findings in 461 patients in a foot and ankle outpatient clinic – definition of standard pedographic patterns for typical pathologies
- O25 Pataky TC New insights into stance phase foot biomechanics using pedobarographic statistical parametric mapping

#### 12.20 – 13.30 Poster Session 3

*Chairmen: Julie Stebbins and Claudia Giacomozzi*

- P34 Cong Y Biomechanical evaluation of shank curves of high-heeled shoes
- P35 Rathgeber T Correlation between foot pronation and overcrossing while running
- P36 du Toit V Angular motion and joint moments at the ankle during aerobic dance movements

- P37 Daisuke K Biomechanical effect of Waraji-like footwear on walking and standing
- P38 Zhang S Coordination in running within high- and low-arched feet
- P39 Cong Y Biomechanical effects of size and shape on footwear fit
- P40 Shultz R Foot kinematics during barefoot running and lateral cutting
- P41 Shariatmadari MR Performance of EVA footwear foam under static pressure and shear force loading
- P42 Chirco S Walking and heels: effects in healthy and flat foot
- P43 Tekautz P Correlation between foot pronation and foot rotation while running
- P44 Hömme AK Analysis of foot morphology and plantar pressures of school children
- P45 De Mits S The relationship between the foot posture index and plantar pressure measurements
- P46 Keijsers NLW Normalization of plantar pressure distribution pattern
- P47 Giacomozzi C Biomechanical interpretation of pressure pattern alterations in diabetes and reumatoid arthritis: the support of cluster analysis
- P48 Stolwijk NM Redistributing plantar pressure; a detailed description of the effect of insoles on plantar pressure distribution in patients with common foot complaints
- P49 Deschamps K Inter- and Intra-observer reliability of landmark placement in plantar pressure measurements
- P50 Olesen CG Does excessive pronation cause pain?
- P51 D'Amico M Normalisation and averaging of baropodographic maps for foot/floor interaction study
- P52 Wolf S CoP data measured with an insole pressure system in a global reference frames
- P53 Demirbuken I Relationship between balance control and footprint parameters

**13.30 – 14.15 Buffet Lunch**

**14.15 – 14.45 Symposium presentation of the European Footwear Technology****14.45 – 16.15 Oral Session 5, Motion Analysis**

*Chairmen: Irene Davis and Mario Lafortune*

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|-----|--------------|--|
| O26 | Wolf S       | Foot motion in children and adults   |
| O27 | Rao S        | Shoe inserts alter inter-segmental foot motion and provide symptomatic relief in patients with midfoot arthritis     |
| O28 | McCahill J   | Use of the Oxford Foot Model in clinical practice  |
| O29 | Shultz R     | Validation of windows for examining kinematics of the foot with respect to the shoe using a multi-segment foot model |
| O30 | Benedetti MG | A new protocol for complete 3D kinematics analysis of the ankle foot complex in stroke patients                      |
| O31 | Rouhani H    | 3D foot joints angle description using projected lines on anatomical planes  |
| O32 | Krauss I     | Comparison of gait data using two different protocols for ankle joint kinematics                                     |

**16.15 – 17.15 Coffee Break & Poster Session 4**

*Chairmen: Smita Rao and Maria Grazia Benedetti*

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|-----|--------------|--|
| P54 | Biagi F      | Skeletal-based animation in multi-segment foot kinematics  |
| P55 | Benedetti MG | Comparison of outputs of different models for multi-segment foot kinematics  |
| P56 | D'Amico A    | Validation of current protocols for multi-segment foot kinematics by elementary joint motion                             |
| P57 | Rosenbaum D  | Effects of medial longitudinal arch supports on three-dimensional foot motion in high and low arched healthy adolescents |
| P58 | Ball KA      | Standardized marker sets are unnecessary: the functional alignment procedure   |
| P59 | Orendurff M  | Acceleration during walking is modulated by the ankle  |
| P60 | Jensen K     | A new motion capture system for automated gait analysis based on multivideo sequence analysis                            |
| P61 | Rabuffetti M | Linked-body model of the foot: identification of a minimal marker set  |

- P62 Tulchin K Multi-segment foot motion changes with speed
- P63 Ball KA Revisiting the ISB recommendation for analysis of ankle movement
- P64 Shultz R Effect of neutral trial conditions on reported foot kinematics
- P65 Peeraer L Prediction of 3-D rearfoot motion based on plantar pressure distribution data during stance
- P66 Mølgaard C Pain reduction in patients with patellofemoral syndrome and hyperpronation treated with orthoses and foot training
- P67 Kogler GF The influence of concave orthotic relief's at the second metatarsal head on plantar foot pressures during walking
- P68 Roosen Ph Plantar pressure measurements while using an Aircast Airlift™ PTTB brace and a Bota ortoAB950 brace
- P69 Bae TS Effect of prosthetic foot eversion on knee and ankle of transtibial amputees
- P70 Rosenbaum D Vacuum cushioned removable cast walkers reduce foot loading in patients with diabetes mellitus
- P71 Cho HS Finite element analysis of the active prosthetic foot for trans-tibial amputee
- P72 du Toit V How effective are orthoses in the treatment of exertional medial shin pain? - a protocol
- P73 Avagnina L The plantar orthotic therapy in forefoot pain with biomechanical origin

**17.15 – 18.30 Consensus Meeting A: International standards for terminology of the foot and ankle biomechanics, chaired by Thomas Greiner**

**17.30 – 18.30 Visit to the hospital-monastery-library A [IOR hospital]**

**20.30 Social dinner [Cantina Bentivoglio via Mascarella 4/B - Bologna city centre]**

# Saturday, 6<sup>th</sup> September 2008

## 7.30 – 10.30 Registrations

## 8.00 – 8.30 Key Lecture 5

*Sorin Siegler* (Department of Mechanical Engineering and Mechanics, Drexel University, USA):  
Advances in image-based biomechanics of the human ankle

## 8.30 – 9.50 Oral Session 6, Medical Imaging Analyses

*Chairmen: Sorin Siegler and Rita Stagni*

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|-----|---------------|---|
| O33 | Yamaguchi S   | In vivo talocrural and subtalar kinematics during nonweightbearing and weightbearing dorsiflexion-plantarflexion activities     |
| O34 | Blankevoort L | The accuracy of a CT-based bone segmentation technique for measuring the range of motion of the joints in the ankle             |
| O35 | Sheehan FT    | Direct in-vivo quantification of the 3D talocrural and subtalar finite helical axes   |
| O36 | Lu TW         | Validation of a voxel-based 2-D to 3-D registration method for measuring natural ankle kinematics with single plane fluoroscopy |
| O37 | Nielsen RG    | The predictive value of the foot posture index on dynamic function  |
| O38 | Drerup B      | Objective foot ulcer documentation using 3-D shape analysis: a feasibility study  |

## 9.50 – 10.30 Coffee Break & Poster Session 5

*Chairmen: Frances Sheehan and Tung-Wu Lu*

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|-----|------------|--|
| P74 | Sheehan FT | In-vivo quantification of the Achilles tendon moment arm   |
| P75 | Petrolo L  | Mechanics of foot and ankle by synchronised measurements from single plane video-fluoroscopy and force plates: preliminary assessments     |
| P76 | Rathleff M | Navicula height – static versus dynamic  |
| P77 | Siegler S  | The effect of loads applied to the infant congenital clubfoot through serial casting on shape, growth and ossification of hindfoot anlagen |
| P78 | Conti G    | Comparison of different reference systems for the human tibia and fibula   |
| P79 | Sancisi N  | Helical axis calculation for human tibiotalar joint motion based   |

on Burmester theory

- P80 Franci R An efficient tool for ligament-bone contact simulation
- P81 Rouhani H Bone embedded anatomical frame definition for multi-segment foot motion description
- P83 Siegler S Relationship between morphology of the ankle joint complex and its mechanics revealed through subject-specific models

### 10.30 – 11.00 Key Lecture 6

*Marco Viceconti* (Laboratorio Tecnologia Medica, Istituto Ortopedico Rizzoli, Italy):  
Multiscale modelling and team science: the future of orthopaedic biomechanics

### 11.00 – 12.30 Oral Session 7, Modelling

*Chairmen: Alex Stacoff and Ilse Jonkers*

- O39 Greiner TM The calcaneocuboid joint moves with three degrees of freedom
- O40 Zavatsky AB Reducing rigid-body error in a functional technique to determine ankle joint axes
- O41 Stagni R A biomechanical model of percutaneous distal metatarsal osteotomy: load transmission influencing successful follow-up
- O42 Caravaggi P Evidence for early stance phase pre-loading of the plantar aponeurosis
- O43 Stephenson J Bearing surface modeling of the talus and calcaneus
- O44 Franci R New spatial mechanisms for the kinematic analysis of the tibiotalar joint
- O45 Ledoux WR A finite element foot model for simulating muscle imbalances

### 12.30 – 13.30 Consensus Meeting B: Towards consensus of reference co-ordinate systems, chaired by Sorin Siegler

### 13.30 – 14.00 Lunch at the Bar/Caffetteria

### 14.00 – 14.15 Poster Session 6

*Chairmen: Vincenzo Parenti-Castelli and Angelo Davalli*

- P84 Matricali GA Changes in contact area characteristics of the ankle after cartilage biopsy at the postero-medial rim of the talar dome

- P85 Spinelli M Total ankle prosthesis: preliminary experimental results on wear rates
- P86 Matricali GA High inter-specimen variability of baseline data for the tibio-talar contact area
- P87 Moon JP Finite Element Analysis on foot pressure changes in relation to outsole hardness
- P88 Creylman V Finite Element Analysis of ankle foot orthoses
- P89 Ruperez MJ A methodology to measure the pressure on the foot surface in a virtual way

**14.15 – 15.45 Oral Session 8, Foot & Ankle Biomechanics**

*Chairmen: Giovanni Matricali and Leendert Blankevoort*

- O46 Hawke F Custom foot orthoses for the treatment of foot pain: a systematic review
- O47 Richter M Intraoperative pedography – development, validation and clinical use of a novel method for intraoperative biomechanical assessment
- O48 Peeters K Effect of external loading on in vitro measured muscle induced calcaneal and talar motion
- O49 Brauner T Gradual increase of varus angle of running shoes gradually reduces pronation while maintaining cushioning properties
- O50 Greiner TM Assessing talonavicular joint rotations in three dimension
- O51 Alimusaj M Effects of an active prosthetic ankle during ambulation on stairs and ramps
- O52 Vannini F Functional evaluation of patients treated with osteochondral allograft transplantation for post-traumatic ankle arthrosis

**15.45 – 16.00 Concluding Remarks and Closing Ceremony,****16.00 – 17.30 Visit to the hospital-monastery-library B [IOR hospital]**