



# IV INTERNATIONAL CONFERENCE ON **BIODENTAL ENGINEERING**

PORTO - PORTUGAL  
21 - 23 JUNE 2016

**U** PORTO  
FEUP FACULDADE DE ENGENHARIA  
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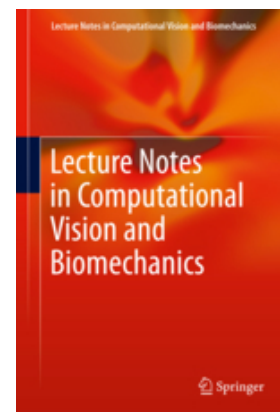
## **CONFERENCE PROGRAM and ABSTRACTS**



**Vila Nova de Famalicão  
Portugal**



# CONFERENCE PROGRAM and ABSTRACTS



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*Mário Vaz*  
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*Yongjie (Jessica) Zhang*



## Partners

Câmara Municipal de Vila Nova de Famalicão



Casa das Artes: integrated in Biodental a painting exposition is presented



Centros auditivos Widex



Biodental 2016 was organized in the scope of Project NORTE-01-0145-FEDER-000022 - SciTech - Science and Technology for Competitive and Sustainable Industries, cofinanced by Programa Operacional Regional do Norte (NORTE2020), through Fundo Europeu de Desenvolvimento Regional (FEDER).





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## VENUE

Casa das Artes  
Av. Carlos Bacelar  
Parque de Sinções  
4760-103 Vila Nova de Famalicão

<http://www.casadasartes.org/>

GPS Coordinates:

N: 41° 24' 50"

W: 8° 31' 03"

Tel.: +351 252 371 304 / +351 252 371 297

e-mail: [casadasartes@vilanovadefamalicao.org](mailto:casadasartes@vilanovadefamalicao.org)





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| <b>Tuesday</b><br>Room: 'Pequeno Auditório' |   |
|---|---|
| 10:30                                       | <b>Registration</b>   |
| 11:30                                       | <b>Opening Session</b>  |
| 12:00                                       | <b>Oral presentations – Session I</b><br>Chairpersons: Mário Vaz / Fernanda Gentil  |
|   | MANDIBLE ANOMALIES – HOW CAN TWO-DIMENSIONAL ULTRASOUND HELP?<br>Inês Côrte-Real, Rosete Nogueira, Ana Cristina Braga, António Felino, Vicente Campos, Francisco Valente, Paula Vaz |
|   | TRIDIMENSIONAL SCAFFOLDS IN BONE REGENERATION<br>Mariane Beatriz Sordi, Isis Carvalho Encarnação, Águedo Aragonês, Mabel Mariela Rodriguez Cordeiro, Ricardo de Souza Magini        |
|   | DEGRADATION OF DENTAL IMPLANT SYSTEMS AFTER IMMERSION IN THERAPEUTIC GELS<br>Gabiella M. P. Juanito, Maithe S. Araujo, Filipe S. Silva, Ricardo S. Magini, Júlio C. M. Souza        |
|   | PALATAL OBTURATORS FOR CLEFT PALATE PATIENTS<br>Marco António Silva, André Correia, Vicente Campos, Teresa Pereira Leite, Reis Campos   |
| 13:00                                       | <b>Lunch</b> ( <i>Massimo Restaurante</i> )   |



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| <b>Tuesday</b><br>Room: 'Pequeno Auditório' |   |
|---|---|
|   | <b>Oral presentations – Session II</b><br>Chairpersons: João Tavares / Paula Vaz  |
| 14:30                                       | <p>CONVERGENCE ANGLE OF PREPARED TEETH FOR FULL CROWNS<br/>Inês Meireles Silva, Alexandra Matos Oliveira, Paulo Rocha-Almeida, Paula Vaz, César Silva, João Sampaio-Fernandes</p> <p>VIRTUAL DIE-SPACING - EVEREST® (KAVO®) SYSTEM EVALUATION<br/>Paulo Rocha-Almeida, JC Reis Campos, Tiago Coutinho Almeida, Paula Vaz, César Silva, João Sampaio-Fernandes</p> <p>SURFACE FINISHING IN TOOTH PREPARATION FOR FIXED PROSTHODONTICS – COMPARATIVE STUDY<br/>Estevão Correia, Paulo Rocha-Almeida, Manuel A Sampaio-Fernandes, Paula Vaz, César Silva, João Sampaio-Fernandes</p> <p>DERMAL ZIGOMATIC PERI-IMPLANT REACTION – GENE EXPRESSION?<br/>Margarida Sampaio-Fernandes, Luís Tovim, Levi Rau, César Silva, João Sampaio-Fernandes, Paula Vaz</p> <p>KAVO PREPASSISTANT® SYSTEM: RELIABILITY<br/>Francisco Maligno, Kevin Oliveira, Paulo Rocha-Almeida, João Carlos Pinho, João Sampaio-Fernandes</p> <p>IMPLANT STABILITY QUOTIENT (ISQ) – FROM SURGERY TO PROSTHETIC REHABILITATION<br/>MA Sampaio-Fernandes, Luís Guilherme Pimentel, Nuno Mesquita Marques, JC Sampaio-Fernandes, Paulo Júlio Almeida</p> |
| 16:30                                       | <b>Welcome Reception and Social Program</b>   |



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| <b>Wednesday</b><br>Room: 'Pequeno Auditório'  |   |
|--|---|
| 09:30  | <b>Invited Lecture</b><br>Beyond the Smile: Psychological Readings of the Teeth in Painting<br>Sofia Torres, Faculdade de Belas Artes da Universidade do Porto<br><br>Chairperson: Reis Campos                |
| 10:30  | <b>Coffee break</b>   |
| 11:00  | <b>Oral presentations – Session III</b><br>Chairpersons: JC Sampaio-Fernandes / Marco Parente   |
|  | DETERMINATION OF OPTIMAL PARAMETERS IN DRILLING COMPOSITE MATERIALS TO MINIMIZE THE MACHINING TEMPERATURE USING THE TAGUCHI METHOD<br>Ana C. Lopes, Maria G. A. Fernandes, João E. Ribeiro, Elza M.M. Fonseca |
|  | CYCLIC TORSIONAL TESTING OF TITANIUM AND ZIRCONIA DENTAL IMPLANTS<br>Marco Martins, José Reis, M. Fátima Vaz, Luís G. Reis  |
|  | TRIDIMENSIONAL SCAFFOLDS IN BONE REGENERATION<br>Mariane Beatriz Sordi, Isis Carvalho Encarnação, Águedo Aragonês, Mabel Mariela Rodriguez Cordeiro, Ricardo de Souza Magini                                  |
|  | NEW STRATEGIES TO ZIRCONIA IMPLANT APPLICATIONS<br>Rafael S. F. Pereira, Filipe S. P. Silva, Bruno Henrique, Márcio C. Fredel   |
|  | INFLUENCE OF SELECTIVE ETCHING ON MARGINAL FILTRATION OF SELF-ETCHING ADHESIVES<br>Sebastiana Arroyo Bote, X. Martinez Arroyo, M <sup>a</sup> C. Manzanares Céspedes  |
|  | MECHANICAL PROPERTIES OF ORTHODONTIC ARCHWIRES: INFLUENCE OF TYPE OF ALLOY AND SURFACE COATING<br>Spalj S, Musa Trolic I, Katic V, Turco G, Contardo L.   |
|  | EFFECT OF DRILL SPEED ON BONE DAMAGE DURING DRILLING<br>Maria G Fernandes, Lucas Azevedo, Renato Natal Jorge, Elza M M Fonseca, João E P C Ribeiro  |
| EFFECT OF THE CHANGE IN THE PH VALUE OF ARTIFICIAL SALIVA ON MECHANICAL PROPERTIES OF ORTHODONTIC ARCHWIRES<br>Katic V, Kamenar E, Zelenika S, Marković K, Spalj S |   |
| 13:00  | <b>Lunch</b> ( <i>Massimo Restaurante</i> )   |



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## Wednesday

Room: 'Pequeno Auditório'

### Oral presentations – Session IV

Chairpersons: Maria Helena Figueiral / Elza Fonseca

14:30

#### AN OVERVIEW OF DENTAL IMPLANT MATERIALS

S. Madeira, O. Carvalho, G. Miranda, J. Caramês, F.S. Silva

#### BENEFITS OF MULTI-LAYERED MATERIALS IN DENTISTRY

Júlio C. M. Souza, Bruno Henriques, Marcio C. Fredel, Filipe S. Silva

#### STRESS DISTRIBUTION AROUND ANGLED IMPLANTS WITH DIFFERENT LENGTHS: AN IN VITRO ANALYSIS

Joana Xavier, Tiago Borges, Marco Parente, Ricardo Faria-Almeida, João Manuel R.S. Tavares

#### SURFACE CHANGES (SCANNING ELECTRON MICROSCOPE) INDUCED BY ARTIFICIAL SALIVA IN STAINLESS STEEL ORTHODONTIC LOOPS

Saúl Castro, Eugénio Martins, Maria Ponces, Jorge Lopes; Maria Pollmann

#### EXPERIMENTAL STUDY OF A NEW BIOMEMBRANE (MES) FOR GUIDED BONE REGENERATION

Raquel Zita Gomes, Isabel Guerra, Américo Afonso, Maria Helena Fernandes, José Cavalheiro, Mário Vasconcelos, Antonio Felino

#### SURFACE ROUGHNESS OF STAINLESS STEEL ORTHODONTIC LOOPS IN ARTIFICIAL SALIVA

Saúl Castro, Ramiro Martins, Reis Campos, Paulo Teles, Maria Pollmann

#### FLEXIBLE PROsthESIS IN POLYAMIDE – LITERATURE REVISION

Rui Costa, Maria Helena Figueiral, José Reis Campos

#### DENTURE ADHESIVES – A REVIEW

Carlos Almeida, Margarida Sampaio-Fernandes, José Reis Campos, José Mário Rocha, Maria Helena Figueiral, João Sampaio-Fernandes

#### FIXED PROsthodontics - CLINICAL VERSUS PRE-CLINICAL PRACTICE

Carlos Almeida, Rui Machado, Orlando Lino, César Silva, João Carlos Sampaio-Fernandes

17:00

**Coffee break**



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| <b>Wednesday</b><br>Room: 'Pequeno Auditório' |  |
|---|--|
| 17:30   | <p><b>Thematic Session on</b><br/><b>Numerical Remodelling Analysis of Bone Tissue – Session I</b></p> <p>Organizers:<br/>Jorge Belinha (INEGI-FEUP), M<sup>a</sup> Cristina Manzanares Céspedes (U Barcelona), António Completo (U Aveiro), Susana Vinga (IDMEC-IST)</p> <p>THE ANALYSIS OF BAR IMPLANTS: A NUMERICAL STUDY<br/>J. Belinha, L.M.J.S. Dinis, R.M.Natal Jorge</p> <p>STRESS ANALYSIS OF 3D TRABECULAR PATCHES: A COMPARISON STUDY<br/>C.I.R.A Maia dos Santos, M.C. Marques, J.Belinha, M.C. Manzanares Céspedes, Catherine Chaussain, R.M. Natal Jorge</p> <p>BIPARTITE MEDIAL CUNEIFORM X-ray MICROTOMOGRAPHIC (<math>\mu</math>CT) IMAGE ANALYSIS<br/>Alicia Baltasar-Sánchez, Ángel González-Sistal, Miquel Dalmau-Pastor, Betlem Fargues-Polo, Maria-Cristina Manzanares-Céspedes</p> <p>A 2D STRESS ANALYSIS OF ZIRCONIA DENTAL IMPLANTS: A COMPARISON STUDY<br/>L.G.Piqueiro, J.Belinha, A.M.R.Correia, L.M.J.S.Dinis, R.M.Natal Jorge</p> <p>MICROSCOPIC AND ULTRAMICROSCOPIC ANALYSIS of "IN VIVO" TREPHINE PATIENT'S BIOPSIES<br/>I. Valdivia-Gandur, E. Sánchez-García, V. Beltrán-Varas, R. Fuentes-Fernández, W. Engelke, C. Bucchi-Morales, MC. Manzanares-Céspedes</p> <p>THE NUMERICAL ANALYSIS OF ANGLED ABUTMENTS USING ADVANCED DISCRETIZATION TECHNIQUES<br/>R.O.S.S. Costa, J. Belinha, L.M.J.S. Dinis, R.M. Natal Jorge</p> |
| 19:30   | <p><b><i>Departure for conference dinner</i></b></p>   |




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## CONFERENCE DINNER

| Conference dinner |  |
|-------------------|--|
| 20:00             | <p>Restaurante</p> <p>Pátio das Figueiras</p> <p>Rua do Além 257<br/>4760-075 Vila Nova de Famalicão</p> |
|                   |                       |



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| <b>Thursday</b><br>Room: 'Pequeno Auditório' |  |
|--|--|
| 09:15  | <p><b>Thematic Session on</b><br/><b>Numerical Remodelling Analysis of Bone Tissue – Session II</b></p> <p>Organizers:<br/>Jorge Belinha (INEGI-FEUP), M<sup>a</sup> Cristina Manzanares Céspedes (U Barcelona), António Completo (U Aveiro), Susana Vinga (IDMEC-IST)</p> <p>DEVELOPMENT OF A STAND-ALONE SOFTWARE IN MATLAB TO RECOGNIZE MULTI-SCALE BONE STRUCTURES BONE<br/>M. Marques, J. Belinha, M.C. Manzanares Céspedes, Catherine Chaussain, R.M. Natal Jorge</p> <p>EFFECTS OF DYNAMIC COMPRESSION ON CELLS IN TISSUE ENGINEERING OF MANDIBULAR CONDYLAR CARTILAGE<br/>S. Cortez, A. Completo, J.L. Alves</p> <p>A NEW BONE TISSUE REMODELLING ALGORITHM COMBINING THE MECHANICAL STIMULI WITH CELLULAR DYNAMICS<br/>M. Peyroteo, J. Belinha, S. Vinga, L.M.J.S. Dinis, R.M. Natal Jorge</p> <p>INFLUENCE OF POROSITY AND CELL DENSITY ON TISSUE ENGINEERING OF MANDIBULAR CONDYLAR CARTILAGE<br/>S. Cortez, A. Completo, J.L. Alves</p> <p>ENDODONTIC-PERIODONTAL LESIONS: A 2D COMPUTATIONAL STUDY<br/>P.F.O. Lopes, J. Belinha, L.M.J.S. Dinis, R.M. Natal Jorge</p> |
| 10:30  | <b>Coffee break</b>  |



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| <b>Thursday</b><br>Room: 'Pequeno Auditório' |  |
|--|--|
|  | <b>Oral presentations – Session V</b><br>Chairpersons: Margarida Sampaio-Fernandes / Renato Natal Jorge  |
| 11:00  | <p>DEVELOPMENT, LABORATORY AND CLINICAL EVALUATION OF A TMJ DISTRACTION DEVICE FOR PATIENTS WITH ARTICULAR DISORDERS<br/>DIAGNOSIS – THE PROJECT.<br/>Júlio Fonseca, Luís Roseiro, Pedro Nicolau</p> <p>IMAGE PROCESSING TECHNIQUES AND ORTHODONTIC RELATED APICAL ROOT RESORPTION PREDICTION MODELS<br/>Sónia Alves, Henriqueta Silva, Luís Mesquita, Nuno Lavado, Miguel Lopez</p> <p>IN VITRO ACCURACY AND SENSIBILITY OF A COMPUTERIZED OCCLUSAL ANALYSIS SYSTEM: T-SCAN III HD<br/>Júlio Fonseca, Mário Martins, Pedro Nicolau</p> <p>ARTICULATING PAPER MARKINGS INTERPRETATION CANNOT ACCURATELY DETERMINE OCCLUSAL FORCE<br/>Júlio Fonseca, Joana Pereira, Pedro Nicolau</p> <p>IN VITRO STUDY OF ANTIFUNGAL DRUG EFFECT IN A TISSUE CONDITIONER<br/>Bibiana M. Assunção, Mariana Henriques, Célia F. Rodrigues, Paula Vaz, Helena Figueiral, Ana Cristina Braga, Sampaio Fernandes</p> <p>RESIDUAL RIDGE RESORPTION IN PATIENTS WITH MANDIBULAR KENNEDY CLASS I REMOVABLE PARTIAL DENTURES<br/>Ana Messias, Fernando Guerra, Maria Augusta Neto, Pedro Nicolau</p> <p>PATIENT-SPECIFIC RECONSTRUCTION UTILIZING COMPUTER ASSISTED 3D MODELLING FOR PARTIAL BONE FLAP DEFECT IN CRANIOPLASTY<br/>Low Peh Hueh, Johari Yap, Abdul Manaf Abdullah, Suzana Yahya, Zamzuri Idris, Zainul Ahmad Rajion, Dasmawati Mohamad</p> |
| 12:30  | <b>Closing Session</b>   |
| 13:00  | <b>Lunch</b> ( <i>Massimo Restaurante</i> )  |

# EFFECT OF DRILL SPEED ON BONE DAMAGE DURING DRILLING

Maria G Fernandes (1), Lucas Azevedo (2), Renato Natal Jorge (3),  
Elza M M Fonseca (4), João E P C Ribeiro (5)

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## Introduction

The bone drilling is a common surgical procedure in clinical interventions including the dentistry. Although not a novelty in medicine, the penetration of a sharp tool in the bone tissue continues to be a clinical and surgical challenge, as many pertinent questions still remain without solutions. Mechanical damage to the bone tissue is one of the common complication associated with the drilling process [1]. An excessive force generated by a cutting tool can lead to the formation of micro-cracks and fractures, and even cause permanent damage in the bone tissue that, in turn, can delay postoperative recovery [2]. The main goal of this paper is to investigate the effect of drill speed on mechanical damage during drilling of solid rigid foam materials, with similar mechanical properties to the human bone. Experimental tests were performed on biomechanical blocks instrumented with strain gauges in different surface positions during the drilling process. Finite element (FE) simulations were performed to simulate the drilling process and validated with experimental results.

## Materials and methods

Experimental tests were conducted on two biomechanical blocks from Sawbones. Several holes were made, at three different drill speeds, in order to evaluate the influence on the drilling process. All the other parameters were considered constant (Table 1). During the perforation the strains were recorded through the linear strain gauges (Figure 1). Numerically, a 3D dynamic model was developed using the ANSYS LS-DYNA. Through the explicit numerical simulation it is possible to explore the effects of different drill speeds on the generated stresses near to the hole and surrounding tissue. The FE mesh is constituted by the drill bit, the block and an internal cylindrical

part with a diameter equal to the drill, as shown in Figure 1.

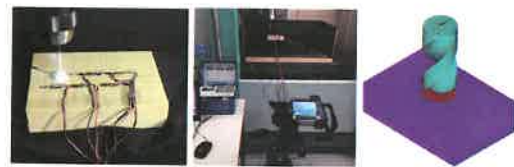


Figure 1: Experimental setup and FE model

Table 1 Parameters considered for both methods.

| Parameters               |                          |
|--------------------------|--------------------------|
| Drill bit                | Ø 4 mm, point angle 118° |
| Drill speed ( $\omega$ ) | 600, 800, 1200 rpm       |
| Feed-rate ( $v_f$ )      | 50 mm/min                |

## Results and Conclusions

In this study, experimental and numerical models are proposed to investigate the effect of drill speed on the stress distribution in bone tissue. The results show that generated stresses in the material tend to increase with tool penetration. Figure 2 illustrates the von-Mises stresses distribution in the biomechanical blocks. A drill bit with a higher drill speed leads to an increase in von-Mises stresses in the bone. The models proved to be an accurate analysis tool to simulate the stresses distribution in the bone during the drilling process.

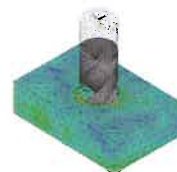


Figure 2: von-Mises stresses distribution in bone.

## References

- [1] Fernandes *et al.* *Proc IMechE Part L: J Materials: Design and Applications*, **0**:1-9, 2015.
- [2] Li *et al.* *J Biomech*, **47**:1117-1126, 2014.