BIODENTAL ENGINEERING 2018

BIODENTAL conference 2018

June 22-23, PORTO, PORTUGAL

ABSTRACTS

ORGANIZING COMMITTEE

Jorge Belinha (ISEP/INEGI)
Renato M. Natal Jorge (FEUP/INEGI)
J.C. Reis Campos (FMDUP/INEGI)
Mario Vaz (FEUP/INEGI)
Sonia Santos (MedSupport)
João Manuel R.S. Tavares (FEUP/INEGI)

biodental.conference@gmail.com
biodentalengineering.wixsite.com/biodental

isep Instituto Superior de Engenharia do Porto

U.PORTO FACULDADE DE MEDICINA DENTÁRIA UNIVERSIDADE DO PORTO

U.PORTO FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

CATÓLICA CBIS CENTRO DE INVESTIGAÇÃO

inegi

FCT Fundação para a Ciência e a Tecnologia

atmosfera m

LABORATÓRIO DE BIOMECÂNICA DO PORTO

NORTE 2020

PORTUGAL 2020

UNIÃO EUROPEIA Fundos Europeus Estruturais e de Investimento

PREFACE

The V International Conference on Biodental Engineering – BIODENTAL-2018 is held from June, 22th to 23th of 2018 in Porto, Portugal. Since its beginning, BIODENTAL is a continuous source of sharing state-of-the-art developments in the scientific and technological fields of Biomedical Engineering and computational and experimental Biomechanics.

This meeting also offers a unique opportunity for joining young and senior researchers and clinicians interested in biomedical and technological applications in dentistry. Thus, one of the chief objectives of BIONDETAL conference series, is to promote and encourage the interdisciplinary discussions among young and seniors researchers and clinicians acting in the dentistry field.

Furthermore, the V International Conference on Biodental Engineering aims to solidify knowledge in the field of engineering applied to dentistry. The dentistry is a branch of medicine with its own peculiarities and very diverse areas of action. The use of new techniques and technologies is currently the subject of great interest, and this conference series (BIODENTAL 2009, 2012, 2014 and 2016) have been a privileged space for discussion among all stakeholders

This year edition, has brought together researchers from around the world representing several scientific fields related to Dental Medicine, Engineering, Biomechanics, Bioengineering, Biomaterials, Experimental Mechanics, Computer Sciences, Computational Mathematics, Hardware Developers and Manufactures, Electronic and Instrumentation, Medical Imaging and Materials Science.

Today, BIODENTAL conference starts to be an important meeting in dental mechanics. In the 2018 edition, more than 60 works were submitted from researchers from Portugal, Spain, France, Germany, Brazil, and Colombia.

This Book of Abstracts contains the synthesis of the papers accepted for oral presentation. Thus, we - the Organizing Committee - would like to express our gratitude to those who contributed to the success of this meeting. The assistance provided by the scientific committee is highly appreciated. A special thanks also goes to the participants and the authors, without whom the BIODENTAL, and this abstract-book, would not be possible.

Porto, June, 22-23, 2018

Jorge Belinha
Renato M. Natal Jorge
J.C. Reis Campos
Mário Vaz
Sónia Santos
João Manuel R.S. Tavares

ORGANIZING COMMITTEE

Jorge Belinha
Adjunct Professor
Department of Mechanical Engineering
School of Engineering, Polytechnic of Porto
job@isep.ipp.pt

Renato M. Natal Jorge
Full Professor
Department of Mechanical Engineering
Faculty of Engineering, University of Porto
rnatal@fe.up.pt.pt

J.C. Reis Campos
Associated Professor
Faculty of Dental Medicine,
University of Porto
reiscampos@gmail.com

Mário Vaz
Associated Professor
Department of Mechanical Engineering
Faculty of Engineering, University of Porto
gmavaz@fe.up.pt.pt

Sónia Santos
CEO of MedSUPPORT
sonia.santos@medsupport.pt

João Manuel R.S. Tavares
Associated Professor
Department of Mechanical Engineering
Faculty of Engineering, University of Porto
tavares@fe.up.pt.pt

SCIENTIFIC COMMITTEE

V International Conference on Biodental Engineering – BIODENTAL-2018
Porto, Portugal, in 22-23 June 2018

THERMAL STIMULATION OF DENTINAL TUBULES

Paulo A. G. Piloto (1), Joana F. Piloto (2)

1. Polytechnic Institute of Bragança, ppiloto@ipb.pt; 2. Faculty of Dental Medicine University of Porto, joana.piloto95@gmail.com

Introduction

Dentine is a permeable mineralised tissue, made with a special geometry. The geometry presents micro tubules with variable dimensions and densities. According to Coutinho *et al* [1], dentine can be subdivided into four different classes, depending on the number and shape of the tubules. This work considers the region near the cusps (class II). Dentine can be directly exposed to high or low temperature, when the tooth is under restoration or due to gingival retraction. This temperature variation can induce pain into the patient. When this thermal stimulation is applied to the enamel, the threshold value for pain due to high temperature is 45°C and the threshold value due to low temperature is 27°C [2]. This investigation aims to validate the numerical model using experimental data obtained from tests developed by Matthews [2] in the teeth of dogs. According to this investigation, the temperature and the electrical activity of two electrodes, located in contact with the pulp region, were measured [2], allowing for a correlation between the thermal stimulus and pain.

Material and methods

The finite element method is used to analyse the effect of the thermal stimulation. The thermal stimulation intends to understand how individual nerves from dentine or pulp region react to the variation of the temperature in the exposed surface of dentine (pain cause). Different thermal stimulus were considered (heating, cooling, cooling after heating and heating after cooling). The cooling stimulus is represented in Fig. 1.

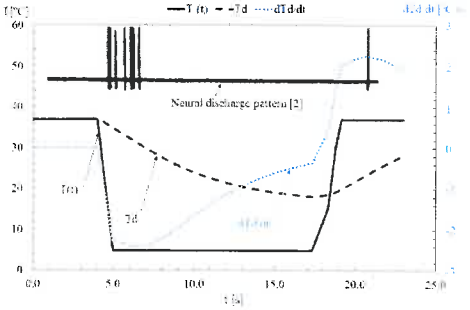

Figure 1: Cold stimulus and thermal reaction at the unexposed surface of dentine, including neural discharge.

The model assumes specific boundary conditions for this thermal analysis. The geometry was regularized to facilitate the construction of the model, based on the density of dentine tubules [1], see Fig. 2. The thermal properties were measured by W. S. Brow *et al* [3].

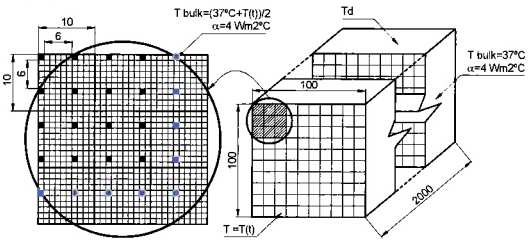

Figure 2: 3D model for dentine (dimensions in μm).

Results discussion and conclusions

The pulp makes recognition of the outside aggressors by sensory afferent nerve fibres (specific receptors of the pain) known as Aβ-fibres, Aδ-fibres and C-fibres. Aδ-fibres are responsible for recognizing electric and cold stimuli that might induce instant sharp pain. The C-fibers are on a deeper location of the pulp, responding only towards intense hot stimulus. The major type of fibres mediating tooth pain sensations are Aδ-fibers and C-fibers [4]. The pain produced under cooling may be attributed with the activation of thermo sensitive receptors (TRPA1 and TRPM8) [4,5], caused by the high rate of temperature variation in the unexposed surface of dentine (according to this research) or with the threshold temperature around the receptors [5]. The pain produced under heating may be attributed to the attainment of a threshold temperature limit. The neural response to cold stimulus differs from the neural response to hot stimulus. Relative long latency is expected in case of hot stimulus, because nerve fibres are less sensitive [5].

References

[1] Coutinho, E. T. ; D'almeida, J. R. M; Paciornik, S.. Evaluation of microstructural parameters of human dentin by digital image analysis. *Materials Research*, v. 10, n. 2: 153-159, June 2007.
[2] Matthews, B. "Responses of Intradental Nerves to Electrical and Thermal Stimulation of Teeth in Dogs." *The Journal of Physiology* 264.3: 641–664, 1977.
[3] Brown, W. S., Dewey, W. A., & Jacobs, H. R. Thermal Properties of Teeth. *Journal of Dental Research*, 49(4), 752-755, 1970.
[4] Le Fur-Bonnabesse, A., A. Bodere, C. Helou, V. Chevalier and J. P. Goulet (2017). "Dental pain induced by an ambient thermal differential: pathophysiological hypothesis." J Pain Res 10: 2845-2851.
[5] Lin, M., Liu, S., Niu, L., Xu, F., & Lu, T. J. Analysis of thermal-induced dentinal fluid flow and its implications in dental thermal pain. *Archives of Oral Biology*, 56(9), 846-854. 2011.