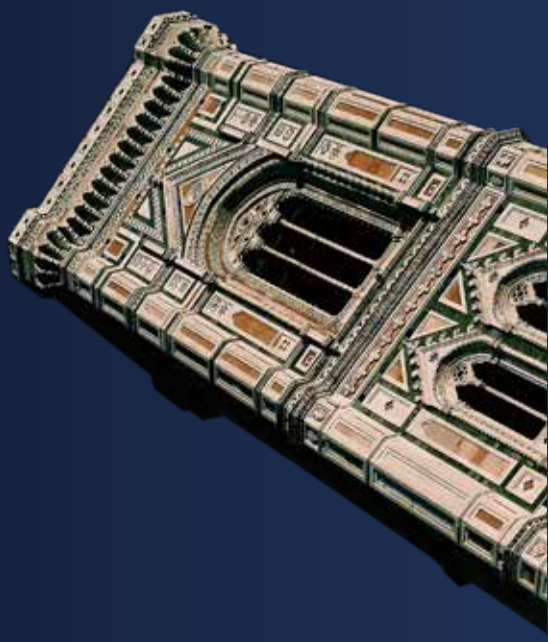
EMSOS
2019

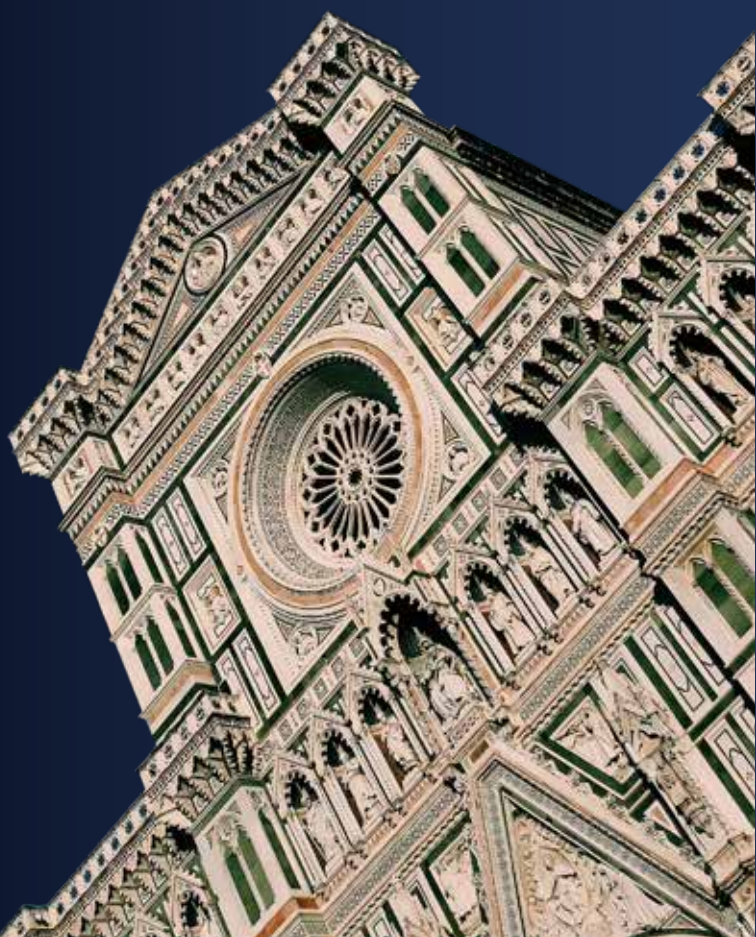
32ND ANNUAL MEETING OF THE EUROPEAN MUSCULO SKELETAL ONCOLOGY SOCIETY

20TH EMSOS NURSE AND ALLIED PROFESSIONS GROUP MEETING

FLORENCE, ITALY · MAY 15-17, 2019
PALAZZO DEI CONGRESSI



ABSTRACT BOOK



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To the Kind Attention of the **Submitter**: Doctor Vania Oliveira

Florence, 22nd March 2019

Dear Doctor Oliveira,

On behalf of the EMSOS Organizing Committee, we are pleased to inform you that abstract:

ID: **2447**
Title: The heat transfer modelling for minimization of bone tumor lesion using the cement polymerization effect
Authors: V. Oliveira, E. Fonseca, J. Belinha, C. Rua, P. Piloto, R. Natal Jorge
Presenter: **Vania Oliveira**
has been accepted as an **ORAL presentation** according to the following schedule:

Session title: **Bone metastases 2 and Mininvasive therapies**
Session date: **17th May 2019**
Session time*: **14:45-16:00**
Allotted time for presentation: **4 (four) minutes**.
***** *session time may change within the session date*

Please note that your presentation must strictly adhere to the allotted time for presentation **the audio will be automatically switched off at the end of the allotted time**. Official language of the congress is English and simultaneous translation will not be provided.

We kindly remind you that as stated on the Congress website **registration is mandatory for participation in the scientific sessions and for oral or e-poster presenters.**

Abstract Presenter needs to register by 10 April 2019, in order to be a confirmed presenter and to have the abstract published on the congress website. Failure to register within the specified deadline will result in the withdrawal of the abstract from the program.

To finalize the Presenter's registration please contact RegistrationEMSOS2019@oic.it or click here https://meeting.oic.it/EventWeb/EventWebNavigationController_491.html?ln=EN **before 10 April 2019**.

To take advantage of the discounted early registration fee please register before 31 March 2019.

Please, advise us whether for some reason the Presenter is NOT able to attend the congress (and the abstract should be CANCELLED), or the presentation will be made from another co-author (please, provide the NAME).
The very last deadline for making any corrections is 19 April, 2019.

We rely on your active participation in the Scientific Sessions of the Congress and look forward to meeting you in Florence!

Best regards,

Giorgia Baschera / Dianora Saccomani
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The heat transfer modelling for minimization of bone tumor lesion using the cement polymerization effect

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Introduction and Purposes: Bone metastases, which are frequently diagnosed late, translate an advanced tumor stage and have a high impact in patients' quality of life and survival. After the diagnosis and tumor staging, it is important to characterize the bone tumor lesions with specific attention to identify the size, type (osteolytic, osteoblastic, mix), location, etc. in the involved bone [1]. Tumors can destroy the spongy and cortical bone and extend to soft tissues. The bone cancer treatment is complex, and can include surgery, chemotherapy and radiotherapy, or other local or systemic treatments combinations, with the aim to cure or control the affected anatomic area. Bone cement (polymethylmethacrylate, PMMA) is widely used in orthopaedic surgeries due to their structural and physical properties, excellent biocompatibility and easy manipulation. This material has an exothermic reaction where volumetric dimension changes during the polymerization process with heat generation [2]. The high heat generated can lead to thermal necrosis of bone cells and also residual stresses formation that can affect the endomedular systems fixation and loosening. Different authors studied the exothermic reaction of cement polymerization and reported in different publications predictive results regarding the temperature rise and residual stresses using time-dependent polymerization function [2], [3]. Others proposed empirical models for the prediction of heat generated using experimental and numerical tests [4], [5]. In this work, the bone cement PMMA was introduced to fill in a metastatic lytic lesion area, which the main objective is playing a promising role for bone tumor necrosis due to thermal effects and biomechanical stabilization for function. All results were presented to promote a discussion for better clinical benefit and if the introduced PMMA is an alternative methodology.

Materials and Methods: Different numerical models were produced representing a two dimensional bone geometry with an external diameter equal to 31,2mm and with cortical thickness of 7.35mm. In the middle of the model was introduced a cement bone with the dimensions equal to H=20mm in depth and variable width L=10, 15, 20, 25 mm. Numerical models were building accordingly to average dimensions obtained from digital medical images from patients and approved from a biomechanical data control group [6]. All thermal material properties (cortical, spongy bone, cement, and endomedular titanium nail) are in accordance with the literature [2], [7]. The time-temperature depend effect in PMMA was introduced in the numerical model according experimental results from literature [5].

Results: The results show that the temperature in PMMA zone reaches the maximum value of 83ºC and that the heat is spread through cortical and spongy bone. Increasing the amount of cement, the affected area in bone tissue also increases. The bone cement interface has a temperature equal to 83 ºC at high temperature PMMA polymerization. The affected thermal necrosis occurs in the same bone area in a region width of 10 mm. For an increase amount of 5mm in the metastatic lytic lesion filled with PMMA cement, the thermal effect produces always more 10mm of surrounding spongy bone necrosis area. When the intramedulary nailing system was reproduced, the bone cement was spread in the same quantities through spongy bone. With the increase of the lytic lesion (and with the consequent increase of PMMA), the heat affects all bone tissue diameter due the good conductivity properties of the titanium endomedular nail. All cement filling the metastatic lytic lesion area affect the spongy bone and the cortical bone, and small cement quantities produce high surrounding temperature distribution.

Conclusions: The results obtained from the numerical analysis using the finite element method permit to conclude about the high temperature spread in bone material. In conclusion, values greater than 47ºC were obtained in models without internal endomedular nail. With high width dimensions for introduced cement material filling a metastatic lytic area, the thermal effect in bone is equal through the horizontal side spread, but increase the bone area in lateral corners of the cement zone. High quantities of cement material produce thermal necrosis in bone more pronounced in depth. When the endomedular nail material is introduced, the quantities effect of cement material induces heat transfer in all model's domain due to the titanium endomedular nail as a good material conductor.

Bone cement filling and the structural statibilization with an endomedular nail appear to have a synergic effect that can be applied to long bones metastatic lytic lesions treatment.

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