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Predictive models and simulations in bone regeneration: a multiscale patient-specific approach

Welcome to our first newsletter

José Manuel García Aznar, Project Coordinator

I am pleased to present the **CURABONE** newsletter.

Curabone arises as a natural result of a long-term collaboration between the international company **Materialise**, engaged in software development and 3D printing, and the **University of Zaragoza**. These entities have already worked together in the project **Cadbone**, being the development of **personalized treatments for bone lesions** the main objective of both actions.

Curabone is a Marie Sklodowska Curie Action ITN-EID funded by the European Commission, in which five selected PhD students participate in a joint **academic and industrial training** to pursue their thesis and become highly skilled researchers.

The research activity carried out in this project aims to improve the **clinical applicability of the numerical algorithms** that simulate the adaptive and regenerative bone responses to each patient needs. The end-goal of this technology is to develop tools that help clinicians to make the most optimal decisions for the treatment of specific patients and to plan their rehabilitation therapies.

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International Workshop on Bone Mechanics and Tissue Engineering



The International Workshop on bone mechanics and tissue engineering will be held in Zaragoza (Spain) in **February 2020**. It is conceived as a sa a training activity with the participation of renowned experts in this field:

- Scott Hollister, Georgia Institute of Technology and Emory University (USA)
- Gwendolen Reilly, The University of Sheffield (UK)
- Bert van Rietbergen, Eindhoven University of Technology (NL)
- Michael Skipper Andersen, Aalborg University (DK)
- José Manuel García Aznar, University of Zaragoza (ES)

The registration is free of charge (deadline January 15th, 2020)

Workshop information







Curabone Consortium Meeting

The CURABONE **Consortium Meeting** was held in Zaragoza on 4h-5th November 2019. Two intense days going over the work done and planning the activities for the coming months in Materialise and Universidad de Zaragoza.



All the ESRs presented their work and their plans for the next months regarding their research work, deliverables, dissemination, outreach and training activities. After the meeting, the ESRs attended a course on Business Models and Product Development, as a part of their Complementary Skills Training programme.

Third Millennium Awards

Thanks to the long-term collaboration between the research group Multiscale in Mechanical and Biological Engineering (M2BE) and Materialise, we have been a finalist of the Third Millennium awards, contest sponsored by Heraldo de Aragon, in the category of **Knowledge Transfer to Industry** with **Curabone**. More than 60 candidates within the community of scientists, researchers and innovators in Aragon have taken part in this fifth edition of the competition.

MSCA-ITN Cluster Event on Personalised Medicine

Maria Ángeles Pérez shared the outputs of the Curabone project in the field of diagnosis and decision support tools at the **MSCA-ITN Cluster Event on Personalised Medicine** held in Madrid (6 -7 November) with our ESR Jonathan Pitocchi, who also presented his poster and got the chance to do networking with delegates of other 14 ITN projects, members of the Research Executive Agency (REA), and representatives of policy-makers (ICPerMed and RTD).



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PhD Students' news



Curabone is an **EID project**, a doctorate programme where five selected young researchers participate in a joint academic and industrial training to pursue their thesis. The selected researchers in CuraBone are exposed to different research environments from companies and universities to hospitals and are guided through an innovative and customized training to achieve the project scientific goals. The aim is for these young researchers to become **top skilled professionals** and the next generation of researchers that responds to public and private needs.



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Gabriele Nasello in the 18th National Day on Biomedical Engineering in Brussels 29/11/19

Gabriele Nasello attended **the National Day on Biomedical Engineering** (NCBME) conference in Brussels. It was a great opportunity to show his in-silico work in a poster and 1-minute talk.

Gabriele Nasello in the 7th Belgian Symposium on Tissue Engineering 16/11/19

Gabriele Nasello took part in the 7th Belgian Symposium on Tissue Engineering at Hasselt University presenting his poster on a **Microfluidic Platform for Osteoblast Differentiation**. It was a good chance to talk to him and learn more about our project.

Jonathan Pitocchi in the Master's Degree in Biomedical Engineering at UNIZAR 29/10/19

On Monday 28th October our ESR Jonathan Pitocchi gave an interesting lecture within the "Interdisciplinary Seminar" section of the Master's Degree in Biomedical Engineering at the University of Zaragoza. The topic was **Pre-operative planning for shoulder implants: the role of an engineer.**

David Leandro Dejtiar, new ESR working in Curabone 10/10/19

A new member in the Curabone team, David Leandro Dejtiar recently joined us hired by Materialise. He's got a **Master Degree in Science and Technology** (Sports Technology) and has been working as a research assistant in the biomechanics group at the University of Aalborg.

Jonathan Pitocchi in ISTA 2019, Toronto 07/10/19

Our ESR Jonathan Pitocchi gave a very interesting talk about **measuring tightening torque and force in screws for shoulder implants** in ISTA 2019 (Toronto). It was an excellent event to get feedback from clinicians and surgeons and optimise our workflow.







Simone Russo in the European Research and Innovation Days 26/09/19

Simone Russo attended the "European Research and Innovation Days". It was the perfect event to have fun with science, to meet old friends and even to meet Marie and Pierre Curie.

Presentation of Gabriele Nasello at KU Leuven International Programmes 2019 18/09/19

Gabriele Nasello made a presentation on his topic **Bone on a chip** at KU Leuven during the International Programme "New Frontiers in Biofabrication: From Biomolecules to Tissues and Organs". It has been a great opportunity to talk about biofabrication with experts around the world and to present his research.

Presentation of Maria Hilvert in the CMBBE 2019 in New York 16/08/19

Maria Hilvert attended the CMBBE in New York (14-16 August), 16th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering and 4th Conference on Imaging and Visualization, and held a presentation there with the title **Bone healing simulation in the mandible after orthognathic surgery**.

Successful participation of our ESRs in the 25th Congress of the European Society of Biomechanics in Vienna 10/07/19

A good part of the Curabone team successfully participated in the 2019 ESB Congress held in Vienna (July 7-10). Our ESRs Gabriele, Simone and Jonathan made some fantastic presentations of their research: **Mechanically driven osteointegration: a numerical model for bone regeneration in porous scaffolds** (Gabriele Nasello), **Polycaprolactone in-silico degradation model: how to predict in-vitro long term behaviour** (Simone Russo), and **Virtual assessment of reverse shoulder implant fixation through statistical model and FE analysis** (Jonathan Pitocchi).

Maria Hilvert presented her research work at her former school in Germany

As a part of the **outreach activities** to be carried out by the project members, our ESR Maria Hilvert presented her research within the Curabone team in her former school in Germany to 100 students of 12th grade. The kids showed great interest in the matter.







Recent Publications on the topic:

Eggermont, F., van der Wal, G., Westhoff, P., Laar, A., de Jong, M., Rozema, T., ... & Verdonschot, N. (2020). **Patient-specific finite element computer models improve fracture risk assessments in cancer patients with femoral bone metastases compared to clinical guidelines**. Bone, 130, 115101

Goetti P1, Becce F2, Terrier A3, Farron A1 (2019). Three-dimensional surgical planning, patient-specific instrumentation and intraoperative navigation in shoulder arthroplasty. Rev Med Suisse, 15(675): 2299-2302.

Geoghegan, I. P., Hoey, D. A., & McNamara, L. M. (2019). Integrins in Osteocyte Biology and Mechanotransduction. <u>Current Osteoporosis Reports</u>, 1-12.

Aldemir Dikici, B., Dikici, S., Reilly, G. C., MacNeil, S., & Claeyssens, F. (2019). A novel bilayer polycaprolactone membrane for guided bone regeneration: combining electrospinning and emulsion templating. <u>Materials</u>, 12(16), 2643

Les, A. S., Ohye, R. G., Filbrun, A. G., Ghadimi Mahani, M., Flanagan, C. L., Daniels, R. C., ... & Green, G. E. (2019). **3D-printed,** externally-implanted, bioresorbable airway splints for severe tracheobronchomalacia. <u>The Laryngoscope</u>.

Ardestani, M. M., ZhenXian, C., Noori-Dokht, H., Moazen, M., & Jin, Z. (2019). **Computational analysis of knee joint stability following total knee arthroplasty**. Journal of biomechanics, 86, 17-26

Partner organisations:





www.curabone.unizar.es



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