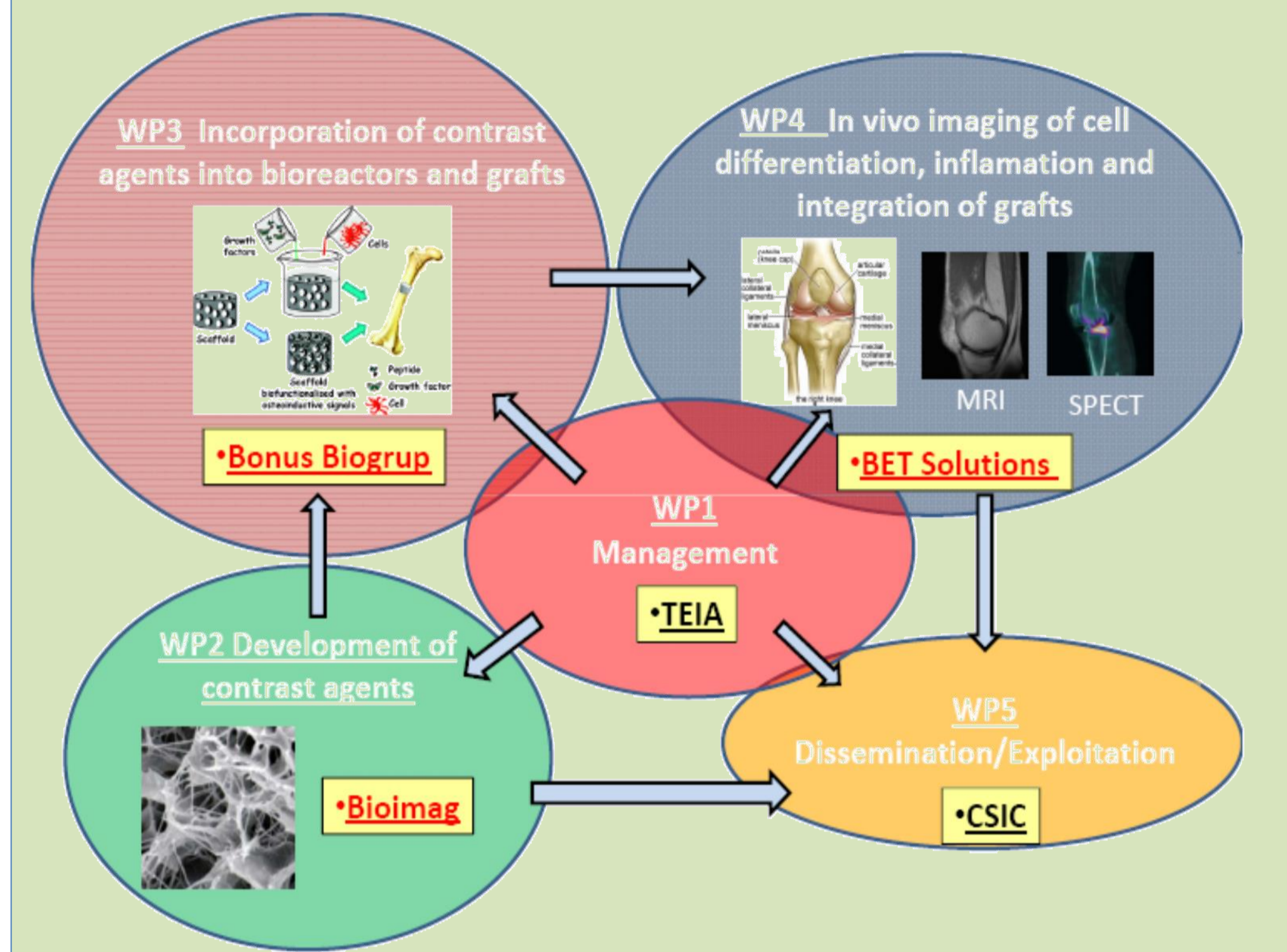


The problem

There is an emerging need for innovative approaches to augment and repair musculoskeletal tissues. Millions of bone grafts are being performed worldwide to repair large segments of bone lost due to trauma, surgery or the removal of cancerous tissue. It is estimated that the bone graft market exceeds \$2.5 billion/year. A continuously ageing population forecasts a steady increase in those numbers.

The main objective of VIVOIMAG is to develop bone implants, including a new contrast agent sensitive to enzymatic activity of metalloproteases, which will permit for the first time to follow the integration and cell differentiation activity in bone tissue bioreactors *in vitro* and in grafts *in vivo*, using existing non invasive magnetic resonance and nuclear imaging techniques.

The project is split into 5 WPs. The WPs are closely interlinked and are schematically described in the diagram below:



VIVOIMAG Objectives

- **Development of new magnetically labelled contrast agents** capable of detecting metalloproteases enzymatic activity. Upon enzymatic degradation, the contrast agent will give different signal detectable with magnetic resonance imaging.
- **Incorporation of these new materials within scaffolds used for bone regeneration.** Mesenchymal stem cells (MSCs), which can self-replicate and differentiate into osteoblasts will be integrated within custom-shaped porous scaffolds for de novo bone formation.
- **Development of bone tissue bioreactors and implantation of regenerated tissue into animal models.** Growth of 3D high-density bone graft based on multi-cells cultures.
- **Exploitation of state of the art MRI and nuclear medicine imaging** to evaluate and optimize the capacity of the contrast agent within the implants for detecting *in vitro* and *in vivo* enzymatic activity of metalloproteases.
- **Local detection of metalloprotease activity in real time** to follow cell differentiation in the bone engineered bioreactor *in vitro* and to follow inflammation, differentiation and integration of the implanted material in the animal models.

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The Consortium

The VIVOIMAG project brings together a **multidisciplinary consortium** of specialists in different areas of bone implant research, nanoparticles formulation and characterization, magnetic resonance and scintigraphic imaging, who join forces in order to propose and assess a novel technique for the evaluation of the progress of bone implants *in vivo*.

Project Partners	Role in the project
National Center for Scientific Research “Demokritos”(DEMO)	Project coordinator; radiolabelling of nanoparticles
Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC)	Functionalization of inorganic surfaces for the development of biosensors
University of Mons (UMONS)	Complete study and characterization of magnetic derivatives and nanosystems
Bonus BioGroup (BONUS)	Pioneer technology for supplying bone regeneration tissues
Bioimag Soluciones de Contraste (BIOIMAG)	Tissue engineering tools to enhance and accelerate therapeutic applications
BET Solutions (BET)	In vivo animal imaging; multi data processing

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