Bioprinting for all the scientific community

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Traditional manufacturing techniques are based on the subtraction of material from a raw block or on modifying the shape by means of an external power source and shaping it using a mold.
3D printing (3DP), AM, rapid manufacturing….are based on the principle of adding material layer by layer allowing the manufacture of complex external and internal shapes with a mesh structure (scaffold).
“We fit the product to the patient not the patient to the product”
3D printing in OS

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Regenerative medicine (RM) is the branch of the medicine that aims at finding solutions to regenerate damaged tissues.

Tissue engineering (TE) is the use of a combination of cells, engineering and materials methods, and suitable signaling factors to improve or replace biological functions.
And what can we do using BP?

Print 3D multi component parts with different materials with a customized external shape and an internal mesh structure that mimic human living tissues.
BP can accelerate the development of new drugs, reduce pre-clinical trials, and the required number of participants in clinical trials, shortening the time to market of new drugs.

We can maintain the environmental parameters under control to ensure the uniformity of the samples.
Where can we find the cells?

Stem cells are all over:

- The blood (Zvaifler et al., 2000)
- The umbilical cordon (Troyer and Weiss, 2008)
- The bone marrow (Jones et al., 2008)
- The adipose tissue (Pittenger et al., 1999; Zuk et al., 2002)
- Amongst others.........
Where can we find the cells?

iPSCs are a type of pluripotent stem cell artificially derived from a non pluripotent cell as somatic cells, by means of inducing the expression of specific genes (Takahashi and Yamanaka, 2006).
And BP will help to convert 2D cultures to 3D and mimic real tissues.

Following the report 3D Bioprinting Market 2014-2030 by Roots Analysis Private Limited 3D, BP will be a multi-billion dollar industry.
And after the printing?

We have a 3D meshed part seeded with cells but this is not a tissue.
And after the printing?

A bioreactor is an engineered device or system that supports a biologically active environment. The bioreactor environment directly affects the uniformity of cell seeding into three-dimensional scaffolds as well as the maintenance of the cell phenotype and characteristics of the tissue.
Can we manufacture organs?

It is not that easy, we still need a lot of research before
Test new structures, cells types, conditions, biomarkers, growth factors, biomaterials, vascularization…. Many researchers have to work hard on that…. 
An what can we offer to them?

A modular 3D bioprinting system that can be adapted to fit the needs of the researchers.

Regenerative medicine professionals just have to think on what new they want to test and we provide the tool.
• **Related to bioprinter technology:** It is necessary the further development of bioprinting technologies compatible with physiologically relevant materials and cells. The resolution and the speed of the printing have to be improved and scaled up for commercial applications. It is also necessary to combine different bioprinter technologies to overcome technical challenges.

• **Related to biomaterials:** It is necessary to develop new biomaterials that mimic the biological materials with similar mechanical and chemical properties. These materials have to be printable and its parameters have to be controllable either during the printing process or afterwards.

• **Related cell sources:** It is necessary the access to well-characterized and reproducible source of cells. A way to increase the proliferation of cells have to be developed. The problems related with SC treatments have to be solved, therefore a better understanding of cell biology at a molecular level is needed.

*Atala et al., 2014*
• **Vascularization and innervation**: If we want to be able to manufacture complex tissues and in the future organs, we need to develop a reliable technology that can manufacture veins, arteries and nerves. These tubes may be manufacturing in the printing process, incorporated afterwards or inducible using pharmacologic or growth factor signalling. But the high 3D non uniformity of vasculature makes difficult to generate these geometries layer by layer. These structures are necessary to generate functional tissues.

• **Related to maturation**: After the printing process, time is required for assembly and maturation before the cells can interact and create tissues. Specific bioreactors have to be developed to maintain tissues *in vitro*, contribute to the nutrient exchange, and reproduce the physiological conditions necessary to create tissues.

   Atala et al., 2014
Can REGEMAT 3D V1 print organs? We can’t, maybe in the USA...., our system can bioprint many different biomaterials and generate own printing code and process to print different kinds of cells in different 3D positions, avoiding high temperatures of thermoplastics depositions.
Is REGEMAT 3D V1 a closed system? Not it isn´t, REGEMAT 3D is a customizable device adapted to the needs and the research of the user. The hardware, the electronics and our software is modular, can be codeveloped and any other feature, parameter or code can be integrated to fit the platform to the application,
REGEMAT 3D is not a company that sells bioprinters... It is a community for researchers that want to beat tissue regeneration related problems and want to use this amazing technology.

bioprinting gateway
Connecting regenerative medicine professionals to boost bioprinting
Is REGEMAT 3D just for cartilage regeneration? No, it isn’t, we have developed an easy adaptable device. Cartilage is going to be our first clinical application (after Ti custom made implants of BRECA Health Care) but we are already working to bring bioprinting to other clinical applications ASAP. Furthermore, the system can be used to *in vitro* create living tissues for drug development.
We used Infrapatellar fat pad (Hoffa’s) and chondrocytes as described in Lopez Ruiz et al., 2013 and induced chondrogenic differentiation of autologous mesenchymal stem cells (MSCs).
Validation of the work station

We had some interesting results

Validated with PLA, alginate and chondrocytes for cartilage regeneration
Comparative results between the use of PLA/Alginate and the addition of Hyaluronic Acid
Coming soon

Another ongoing trials in Cartilage regeneration
PGL and PCL, MSC vs Chondrocytes, addition of lymphocytes, addition of VEGFs, TGF, GDF....
Another research lines with our current partners

- Clinical application of bioprinting in the **regeneration of cartilage**
- Regeneration of **neural tissue**
- Development of new bioprinting process with application in the **pharmaceutical industry** and **encapsulation**
- Bioprinting of **cornea**
- Development of new **biomaterials** for bioprinting
- Bioprinting of **bone**
- Bioprinting of **heart valves**
- Bioprinting of **intervertebral discs**
- Bioprinting of **endocrine glands**
- Bioprinting for **dental applications**
Another research lines with our current partners

- An other coming: skin, breast, tumoral models…

We hope you join us soon!!
QUESTIONS ¿?

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