Engineering new processes of direct bioprinting for skin regeneration

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SUMMARY

The use of 3D bioprinting processes to produce biological substitutes is helping medicine to take significant step to face new realities. We present a work which comprises the development of a robotic system for the *in situ* direct bioprinting of hydrogel-based biomaterials with growth factors and cells for skin injuries, in a customized and minimally invasive way.

print ON organs

INTRODUCTION

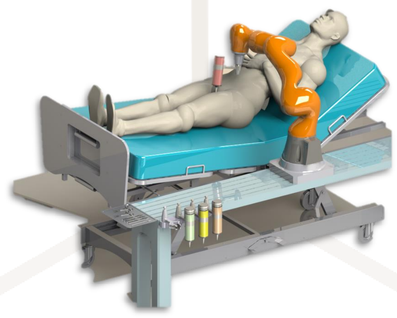
Skin provides an important role of protecting internal organs and tissues from external environment, potentially dangerous insults of daily life. Loss of large parts of this barrier, be it related to illness or injury, renders the individual susceptible to disability or death [1]. So wound healing must be set in motion immediately following injury or trauma to restore the normal structure and function of skin [2]. The standard clinical treatments to support wound repair and regeneration include autografts, allografts, dermal substitutes, cell therapy and cytokine therapy. However, these approaches are often limited by the availability of donor skin for grafting, secondary injuries, small repair range, immune rejection, long-term treatment and are expensive [2].

Tissue-engineered skin substitutes are believed to overcome the limitations of conventional skin therapy methods. 3D bioprinting is an actively studied method in tissue engineering since it shows effective control over biomaterials deposition and cell distribution to engineer complex 3D structures. Hydrogel 3D printing with incorporation of cells and biological molecules is a promising strategy to enable rapid, reliable and scalable production of biomimetic skin substitutes to meet the clinical requirements for skin regeneration [3, 4].

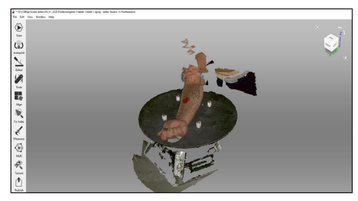
We present a work aiming to bring 3D Bioprinting technologies from the bench-to-bedside and promote a better mimicry of the characteristics and properties of the native tissue improving skin regeneration. This will open doors to faster and customized procedures, with reduced recovery times.

SKIN 3D BIOPRINTING CONCEPT

- Skin bioprinter prototype concept



- 3D scanning of wound, imaging data treatment and development of a output code for biomaterials deposition



- Preparation and deposition of hydrogels with cells and growth factors

CONCLUSIONS

This study demonstrates the concept of PrintOnOrgans project, which is related with the development of a skin 3D bioprinting system with incorporated imaging technology. This system will allow to measure wounds regional anatomy and promote deposition of appropriate hydrogels, growth factors and cell types to accelerate skin regeneration. Besides *in vivo* studies are necessary to evaluate rate wound healing, the achieved results suggest that our skin 3D bioprinting technology can be an interesting strategy for wound treatment.

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