Effects of Leukocyte-Platelet Rich Fibrin and Nanoporous Scaffolds on Cell Proliferation and Cell Migration

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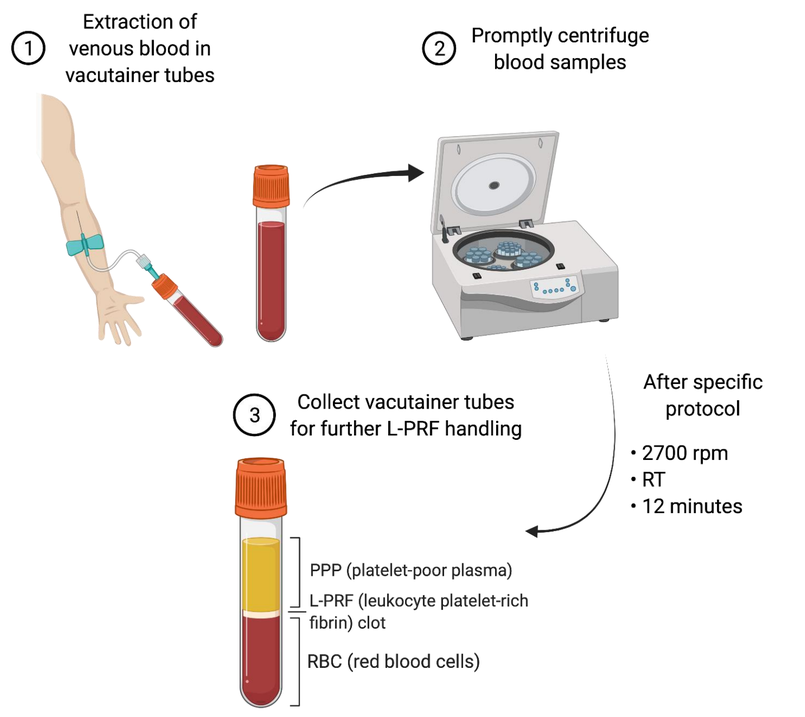
Abstract

In regenerative medicine, repair and regeneration of defects and damage in both soft and hard tissues still remain a challenge. Hence, better bioengineering strategies and biomaterials are needed. Autologous platelet concentrates are potential tools from which regenerative medicine can benefit. The Leukocyte-Platelet Rich Fibrin (L-PRF) is a sub-family of the PRF concentrates that has been in the spotlight because of its simplicity. The presence in its enriched solid three-dimensional fibrin matrix of leukocytes, proteins, cytokines, growth factors, and stem cells give this biomaterial angiogenic, osteogenic, hemostatic, anti-inflammatory, antimicrobial, analgesic, and wound healing properties. Polymeric substances, such as PLGA have demonstrated potential to operate as a scaffold for bone volume augmentation. The ability to tailor the material's properties at the molecular level is one the benefits that allow these materials to be used as proper scaffolds for cells.



Platelet Concetrate Preparation (Clinical view/Representation)

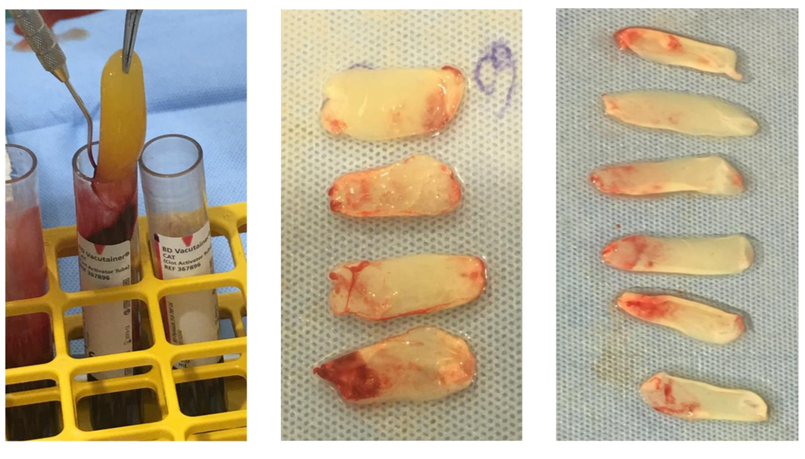


Figure 3. ***Preparation of L-PRF membranes.*** *Created with BioRender.*

Results

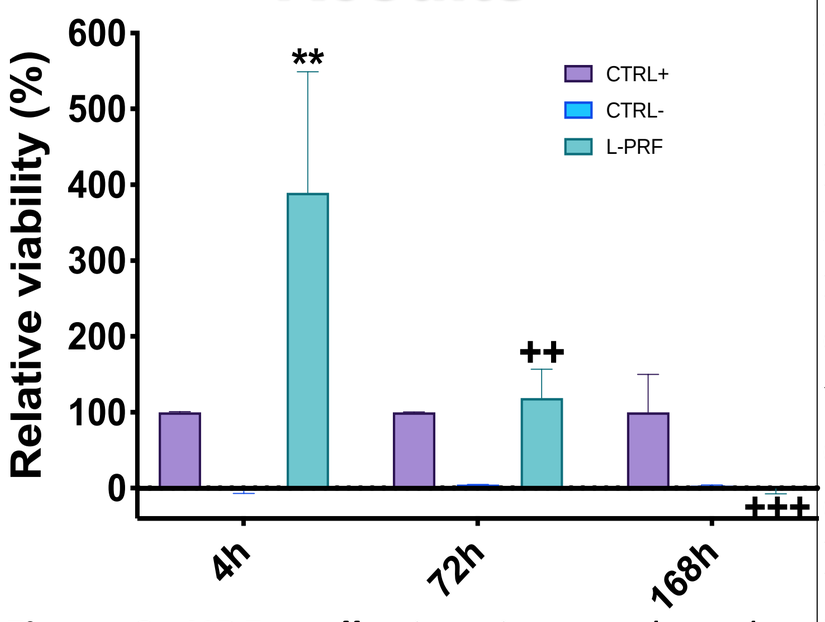


Figure 2. ***HDFn cell*** *migration test based on PrestoBlue™ cell viability based on* ***fluorescence measures*** *at different times.*

Cell viability assays with L-PRF membrane inside the well at the moment of performing the PrestoBlue™ assay showed an increase in cell viability of 289% and 19% after 4 and 72-h treatment, respectively. Nevertheless, the result of the 168-h treatment showed a 100% decrease in cell viability that may be due to the lack of nutrients at this time in the medium.

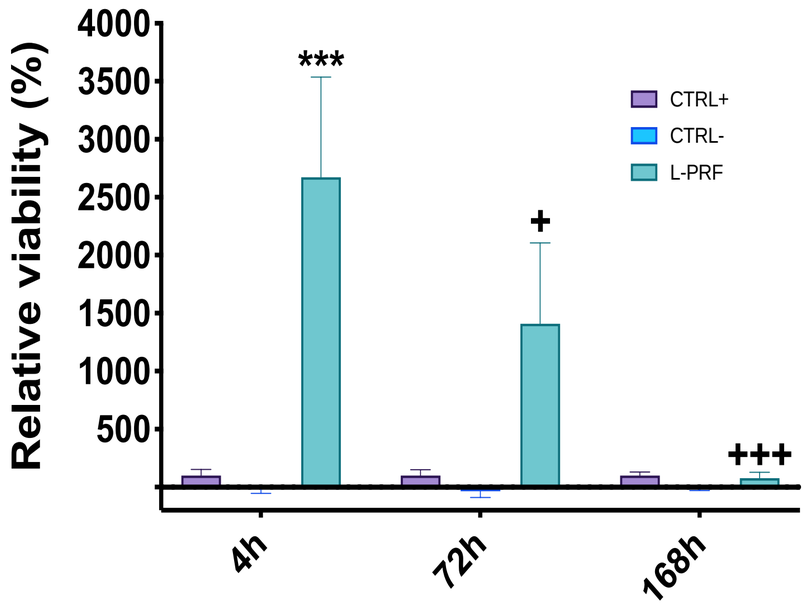


Figure 3. ***HDFn cell*** *migration test based on PrestoBlue™ cell viability based on* ***absorbance measures*** *at different times.*

Cell viability assays in which the piece of L-PRF membrane and the HDFn cells were seeded at the same time, and the piece of L-PRF membrane was inside the well at the moment of performing the PrestoBlue™ assay showed a great increase in cell viability by more than 2.500% after 4-h treatment, and an increase by more than 1.300% after the 72-h treatment. In addition, the results from the 168-h treatment revealed a slight decrease of 23% in cell viability compared to its positive control

Discussion

Despite their demonstrated effectiveness, each type of graft material has its own set of drawbacks. Because of the flaws in each graft material, clinicians must use cautious clinical judgment to choose the type of transplant that has the fewest side effects. In the realm of bone tissue engineering, a tunable material with low co-morbidity, adverse effects, and a low cost is ideal. In the case of L-PRF, it has great results in clinical uses. However, from the engineering aspect, L-PRF has a rapid degradation rate out of the body, making it a difficult material to be produced in greater quantities. Due to this issue, it is important the production of synthetic alternatives that can be easily made with current technologies like electrospinning.

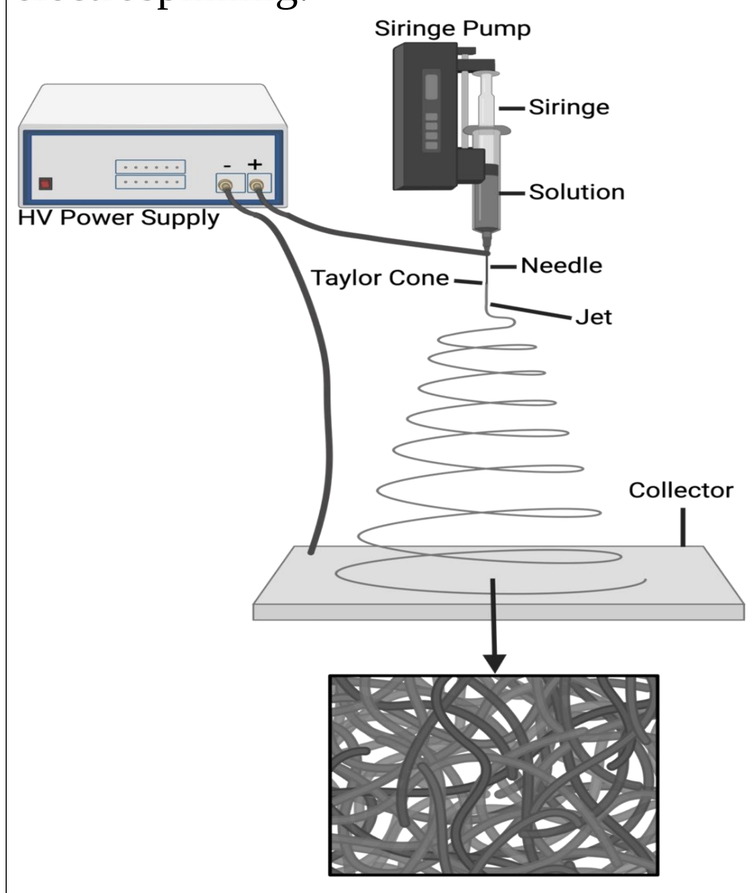


Figure 4. ***Schematic of electrospinning set-up.*** *Created with BioRender.*

Conclusion

As L-PRF membranes shows a robust therapeutic potential in assisting bone and soft recovery in the repair and regeneration, it would be ideal the concept of a synthetic nanoporous scaffold that can mimic and enhance the therapeutic effects of L-PRF in wound healing. The proposed alternative can be produced with current solutions.

References:

[1] Alcivar AS. Effects of Leukocyte-Platelet Rich Fibrin Membranes on Cell Proliferation and Cell Migration [thesis]. Urcuquí (EC): Yachay Tech University; 2020

[2] Witek L, et al. (2020). The effect of platelet-rich fibrin exudate addition to porous poly(lactic-co-glycolic acid) scaffold in bone healing: An in vivo study. J Biomed Mater Res - Part B Appl Biomater, 108:1304–10.