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Research

Photothermal Biomodulated Platelet-rich Plasma Improves Preservation of Hair Grafts and Extends Their Viability

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Summary: Hair transplantation effectively treats alopecia, and hair graft viability is crucial for its success. The study aimed to assess the use of preconditioned autologous platelet-rich plasma with photothermal biostimulation as a graft preservation solution to increase the viability time of follicular units before transplantation. The study was conducted as a proof of concept. The platelet-rich plasma photothermal biostimulation was conducted using the MCT System, exposing the sample for 15 minutes to 623 nm red light with an intensity of 0.5 J/cm² and a temperature of 4 °C to obtain the MCT Plasma. Grafts of volunteers were collected and preserved in 2 Petri dishes per preservation solution (MCT Plasma + phosphate-buffered saline, Ringer's lactate, and saline solution). Graft viability was evaluated in 6 random follicular units at 5, 6, 7, and 8 hours with 0.4% Trypan blue stain diluted at 1/6 with NaCl 0.9%. Twenty-eight male volunteers were included with a mean age of 41 (SD 8.14, range 29–59). A total of 240 grafts were collected from each subject and distributed equitably in 2 Petri dishes for each preservation solution. At 8 hours, only grafts preserved in MCT Plasma with phosphate-buffered saline survived. MCT Plasma maintained hair follicle viability more effectively before transplantation than the saline solution or Ringer's lactate, demonstrating its efficacy as a preservation solution. Hair grafts preserved in MCT plasma with phosphate-buffered saline remained viable for eight hours following extraction, 2 hours longer than with the other tested solutions. *(Plast Reconstr Surg Glob Open 2025;13:e6789; doi: 10.1097/GOX.0000000000006789; Published online 9 May 2025.)*

INTRODUCTION

Hair transplantation has reached considerable popularity for alopecia treatment due to its natural results,[1] and the preservation solution plays a crucial role because it influences graft survival.[2] As the newer techniques have increased the number of implanted follicles, the preservation time has also increased. Consequently, grafts' time exposure to the preservation solution has increased.[3] For this reason, specialized solutions are currently being designed to extend the viability of cells and tissues, keeping the grafts in an environment similar to the scalp.[4] One option is using autologous platelet-rich plasma (PRP) because it can promote hair growth, stimulate cell survival and proliferation, and prolong the anagen phase.[5]

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Photothermal biostimulation or photothermal biomodulation is a novelty procedure for cell preconditioning that enhances PRP properties.[6] Its application to autologous PRP for hair graft preservation purposes could extend the viability of follicular units (FUs).

The study aimed to assess the use of preconditioned autologous PRP with photothermal biostimulation as a graft preservation solution to increase FU viability time before transplantation.

MATERIALS AND METHODS

Study Design

The study was conducted as proof of concept at (removed for anonymization purposes) (Madrid, Spain) to assess the viability of FUs from male volunteers with androgenic alopecia preserved in preconditioned PRP/phosphate-buffered saline (PBS), saline solution (SS), and Ringer's lactate (RL) (Fig. 1). The donors selected were healthy male adults from 25 to 60 years of age. Patients with systemic diseases, pathological blood test

Disclosure statements are at the end of this article, following the correspondence information.

results, scalp damage, or pathological conditions were excluded.

The research adhered to the revised Declaration of Helsinki and the Good Clinical Practice principles and complied with all applicable laws and regulatory requirements relevant to the use of devices in Spain. All patients signed an informed consent before participating.

Study Procedures and Variables Assessed

PRP Obtention and Photothermal Biostimulation

Fifty milliliters of blood were extracted from each donor using closed blood processing systems. Samples were centrifuged for 10 minutes at 3000 rpm (Nahita-Blue Fugelab-GB10, Innovagen, Madrid, Spain), and 20 mL of PRP was obtained.

The PRP photothermal biostimulation was conducted using the MCT System (Meta Cell Technology, Sant Cugat, Spain), a novel cell preconditioning device comprised of

Takeaways

Question: How can we improve the properties of hair graft preservation solutions to align them with new transplantation techniques requiring more prolonged preservation periods?

Findings: Photobiomodulation preconditions platelet-rich plasma (PRP) by improving its properties, increasing growth factors and cytokines released by alpha granules. The study showed that when preconditioned PRP was used as an additive to preservation solution, it improved hair graft survival with an extension of its viability.

Meaning: Preconditioned PRP can mimic the scalp environment and adapt preservation solutions to novel hair transplantation techniques that are able to implant a significant number of follicular units requiring extended preservation periods.

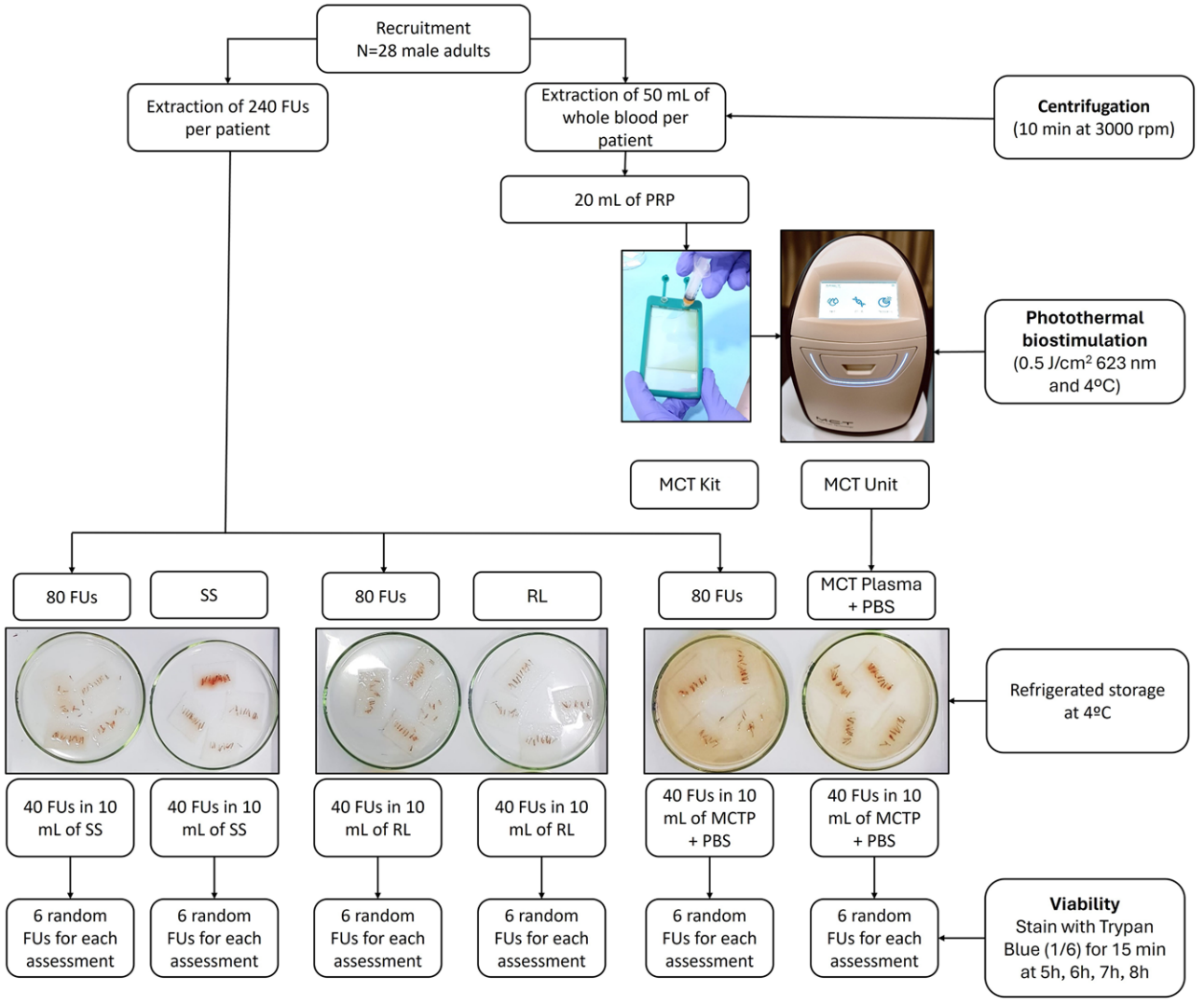

Fig. 1. Study design. rpm, revolutions per minute; MCTP, photothermal-biostimulated plasma.

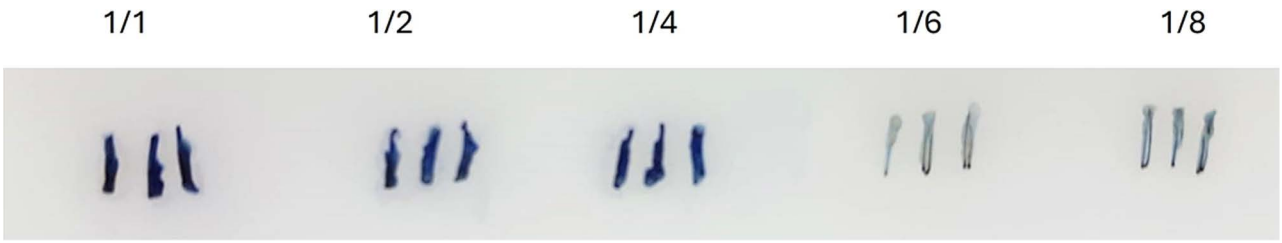

Fig. 2. Trypan blue stain 0.4% dilutions with NaCl 0.9% to decide which was the most suitable to assess FU viability.

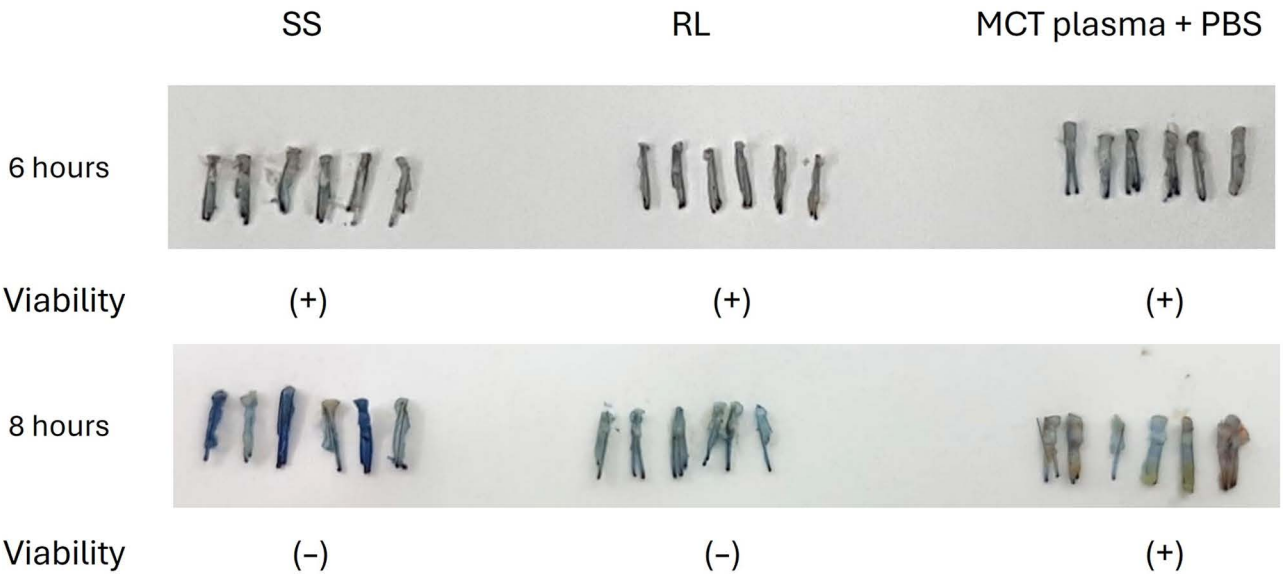

Fig. 3. Follicular units stained with Trypan blue diluted at 1/6 with NaCl 0.9% for the viability assessment at 6 and 8 hours. (+), light blue = high viability; (±) blue = moderate viability; (–) dark blue = low viability.

the MCT Unit and the MCT Kit (a sterile 10 mL single-use container manufactured with a medical-grade special polymer). The 20mL of PRP were equally distributed in 2 MCT Kits. Subsequently, the MCT Kit was placed into the MCT Unit, and the sample was stimulated for 10 minutes with 623 nm red light with an intensity of 0.5 J/cm^2 and a temperature of 4 °C (Fig. 1).

Hair Graft Obtention and Preservation

A total of 240 FUs were obtained from each donor, with 80 equitably placed in 2 Petri dishes with 10 mL of SS 0.9% (ERN Laboratories S.A., Barcelona, Spain), 80 in 2 Petri dishes RL (Braun Lactato-RingerVet, B. Braun Vetcare S.A., Barcelona, Spain), and 80 in 2 Petri dishes with 8 mL of MCT Plasma and 2 mL of PBS (Gibco PBS pH 7.4). All grafts were maintained in each petri dish at 4 °C until the viability assessment (Fig. 1).

Graft Viability Assessment

The viability was assessed by staining the FUs with Trypan Blue Stain 0.4% (Gibco-Life technologies, NY). The stain was tested in several dilutions with NaCl 0.9% (Vitulia physiological serum, Laboratorios ERN, S.A.), and 1/6 was the selected dilution (Fig. 2). Viability was assessed at 5, 6, 7, and 8 hours. At each evaluation, 6 randomized grafts (using a list of random numbers) of each preservation solution were stained for 15 minutes (Fig. 1). A subjective semiquantitative assessment was conducted based on 3 levels: dark blue represents low viability (–), blue represents moderate viability (±), and light blue represents high viability (+).

RESULTS

Twenty-eight adult male volunteers were included, with a mean age of 41 years (SD 8.14; range 29–59 y). Two hundred forty FUs were obtained from each donor, 80 preserved with MCT Plasma/PBS, 80 with SS, and 80 with RL. All follicles preserved with MCT Plasma/PBS, SS, or RL were viable until 6 hours after extraction (Fig. 3). After 7 hours, only a few FUs of those preserved at SS and RL and all preserved in MCT Plasma/PBS were viable. At 8 hours, the grafts preserved in SS and RL were markedly blue stained, which indicated their nonviability for transplantation, and those FUs preserved in MCT Plasma/PBS showed a high viability (+) (Fig. 3).

DISCUSSION

The preservation solution is essential for the hair graft's viability. Our study showed that grafts stored in a solution containing MCT Plasma/PBS remained viable

for 8 hours, 2 hours longer than those preserved with SS or RL. The rationale of these results would be related to the PRP properties in addition to those of PBM. PBM enhances the release of platelet-derived growth factor, basic fibroblast growth factor, transforming growth factor ß, vascular endothelial growth factor, interleukins, hormones, and several hundred other proteins released by platelets.[7] PBM increases complexes I, II, III, and IV, and succinate dehydrogenase activity in the electron transfer chain.[8]

Other authors have assessed the efficacy of new preservation solutions for increasing hair graft viability compared with standard solutions such as SS and RL. Raposio et al[9] found a significant increase in the survival rate of hair micrografts pretreated with adenosine triphosphate-magnesium chloride and deferoxamine mesylate compared with those preserved with isotonic saline. Another study compared a preservation solution developed by the Hair Science Institute with SS and RL Braun.[10] The results showed that the graft's viability was longer in those FUs preserved with the Hair Science Institute solution. One randomized controlled trial added PRP to Williams' Medium E and RL and found that hair follicle grafts exhibited higher levels of CK15 expression than those without PRP.[2] A split scalp study kept the grafts in autologous plasma or RL.[11] At 12 and 72 hours, grafts stored in plasma showed higher hair follicle cell survival. A randomized controlled trial found that preserving hair grafts in PRP increased hair density, graft uptake, and hair thickness compared with those preserved in SS.[12] Based on the findings of previous studies and the advantages of photograph biostimulation in enhancing cell properties, the use of MCT Plasma may prove beneficial for graft preservation.

The pilot study was limited by the small number of grafts, and the only use of the Trypan blue stain to assess the results. As it was a preclinical study, it was not designed to assess postimplantation viability. As we have determined that MCT Plasma has longer viability than standard preservation solutions such as PBS or RL, we should design another study with more sensitive parameters to compare the preservation properties of MCT Plasma with those of standard PRP before and after hair graft implantation.

CONCLUSIONS

MCT Plasma maintained hair follicle viability more effectively before transplantation than the SS or RL, demonstrating its efficacy as a preservation solution. Hair grafts preserved in MCT Plasma/PBS remained viable for 8 hours following extraction, 2 hours longer than with the other tested solutions. After these findings, more research needs to be carried out.

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DISCLOSURES

Meta Cell Technology S.L. provided the MCT System device for the study and covered the costs of medical writing support, but did not provide personal fees. Dr. Pinto is a scientific advisor at Metacell Technology; however, he did not receive any fees for conducting this study. The other author has no financial interest to declare in relation to the content of this article.

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