Research Article ISSN 2690-537X

Dermatology Research

Bacterial Cellulose Gel in Regenerative Dermatology: A New Approach to Post-Fractional CO_2 Laser Skin Repair

Laila Klotz de Almeida Balassiano, MD[1]*, Camila Safranski Martins[2] and Dioney Neves, PhD[3]

[1]*Dermatologist – PhD student, Department of Design, Pontifical Catholic University of Rio de Janeiro (PUC-Rio); MSc in Clinical Medicine, Federal University of Rio de Janeiro (UFRJ); Board-Certified Dermatologist by the Brazilian Society of Dermatology (SBD).*

[2]*Nurse, Unioeste State University of Western Paraná, Cascavel, Paraná, Brazil. Specialist in Clinical Dermatology and Specialist in Health Management from Brazilian Society of Wound Nursing (Sobenfee), São Paulo, Brazil.*

[3]*PhD in Chemical Engineering, Federal University of Santa Catarina, Florianópolis, R&D Manager at Missner, Blumenau, Santa Catarina, Specialist in Innovation, Research and Development (25 years). 5 product patents, 3 unique product developments manufactured in Brazil. Blumenau, Santa Catarina, Brazil.*

***Correspondence:**

Laila Klotz de Almeida Balassiano, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), E-mail: lailaklotzderma@gmail.com.

Received: 05 Sep 2026; **Accepted:** 18 Oct 2026; **Published:** 24 Oct 2026

Citation: Laila Klotz de Almeida Balassiano, Camila Safranski Martins, Dioney Neves. Bacterial Cellulose Gel in Regenerative Dermatology: A New Approach to Post-Fractional CO_2 Laser Skin Repair. Dermatol Res. 2026; 8(2): 1-3.

ABSTRACT

Background: *Fractional ablative CO_2 laser resurfacing is widely used for skin rejuvenation and scar treatment but induces controlled skin injury associated with erythema, edema, discomfort, and recovery time. Optimizing post-procedure care is essential to improve clinical outcomes and patient experience.*

Objective: *To review the role of bacterial cellulose-based hydrogels in promoting skin repair following fractional CO_2 laser procedures.*

Methods: *A narrative literature review was conducted focusing on regenerative biomaterials, bacterial cellulose properties, and post-laser skin care strategies.*

Results: *Bacterial cellulose demonstrates high biocompatibility, nanofibrillar architecture similar to the extracellular matrix, and remarkable water retention capacity. These properties support epithelialization, hydration, and barrier protection. BC-based hydrogels may reduce inflammation, improve comfort, and enhance healing in post-laser skin recovery.*

Conclusion: *Bacterial cellulose-based hydrogels represent a promising strategy in regenerative dermatology, with potential to optimize post-procedure outcomes and reduce downtime. Further clinical studies are needed to strengthen the evidence for routine use.*

Keywords

Bacterial cellulose, Fractional CO_2 laser, Regenerative dermatology, Wound healing, Biomaterials, Hydrogel dressings.

Introduction

Wound healing is a complex and dynamic biological process initiated immediately after tissue injury, aiming to restore skin integrity and function. It involves overlapping phases: hemostasis, inflammation, proliferation, and remodeling. Despite being essential, this process may result in undesirable outcomes such as scar formation, functional impairment, and aesthetic compromise, impacting quality of life [1].

Advances in regenerative medicine and tissue engineering

have expanded therapeutic strategies to enhance tissue repair. Biomaterials have gained prominence due to their ability to provide structural support, modulate the healing environment, and facilitate cellular activity. These materials can also act as carriers for bioactive molecules, contributing to improved regenerative outcomes [1,2].

Among emerging biomaterials, bacterial cellulose (BC) has attracted increasing attention. Produced by non-pathogenic bacteria, BC is a highly pure polysaccharide composed of β-(1→4) linked D-glucose units. Compared to plant cellulose, it exhibits superior physicochemical properties, including high crystallinity, tensile strength, and biocompatibility [3-5].

Bacterial Cellulose and Its Role in Tissue Regeneration

BC presents a three-dimensional nanofibrillar network that closely resembles the extracellular matrix (ECM), particularly collagen architecture. This structural similarity supports cellular adhesion, proliferation, and migration—key processes in tissue regeneration [6].

One of the most distinctive features of BC is its high water retention capacity, which allows it to maintain a moist wound environment. Moisture balance is a critical factor in wound healing, as it promotes epithelialization, reduces tissue dehydration, and minimizes scar formation [4-10].

Additionally, BC dressings enable gas exchange while acting as a physical barrier against external contaminants. Although BC does not inherently possess antimicrobial properties, its dense nanostructure contributes to protection against microbial invasion [10-12]. Furthermore, it can be functionalized with antimicrobial agents or bioactive compounds, expanding its clinical applicability [11,12].

Due to these characteristics, BC has been investigated in various clinical contexts, including burns, pressure injuries, chronic wounds, donor sites, and traumatic injuries [3-5,12].

Fractional CO_2 Laser and the Importance of Post-Procedure Care

Fractional ablative CO_2 laser resurfacing is widely used in dermatology for skin rejuvenation, scar treatment, and wrinkle reduction. The procedure induces controlled thermal injury to the epidermis and dermis, stimulating collagen remodeling and tissue regeneration [7,8].

However, this controlled injury is associated with predictable adverse effects, such as erythema, edema, burning sensation, and temporary impairment of the skin barrier. Recovery time and patient comfort are critical factors influencing treatment adherence and satisfaction [7,9].

Appropriate post-procedural care plays a fundamental role in optimizing outcomes. Strategies that maintain hydration, protect the skin barrier, and support regeneration are essential to reduce complications and shorten downtime [7,9].

BC-Based Hydrogels in Post-Laser Skin Repair

BC-based hydrogels have emerged as promising options for post-laser care due to their multifunctional properties. When combined with polymers such as alginate, BC can form cohesive hydrogel matrices through ionic crosslinking, enhancing mechanical stability and adaptability to the skin surface [4,12].

These hydrogels provide a moist and protective microenvironment that supports tissue repair. Their high water content contributes to hydration and thermal regulation, which may help dissipate heat generated during laser procedures, reducing discomfort [10-12].

The flexibility and conformability of BC hydrogels allow them to adapt to irregular anatomical areas, such as the face, without restricting movement. This characteristic improves patient comfort and usability compared to traditional dressings [4,10].

In addition, BC-based systems have shown potential as delivery platforms for active ingredients, enabling sustained release of therapeutic agents that may further enhance healing and skin regeneration [13-16].

Clinical and Biological Implications

The application of BC in dermatologic procedures aligns with key principles of regenerative medicine, including the creation of a favorable microenvironment for healing and the support of endogenous repair mechanisms [1,2].

By maintaining hydration and mimicking the extracellular matrix, BC-based materials may facilitate faster epithelialization and reduce inflammatory responses [4,6,10]. These effects are particularly relevant in procedures involving controlled skin injury, such as laser resurfacing.

Furthermore, the use of advanced biomaterials in post-procedure care reflects a shift toward more sophisticated and biologically oriented therapeutic approaches in dermatology [11,12].

Conclusion

Bacterial cellulose represents a promising biomaterial in regenerative dermatology, particularly in the context of post-fractional CO_2 laser care. Its unique structural and physicochemical properties enable the formation of a moist, protective, and biocompatible environment that supports tissue regeneration.

BC-based hydrogels may contribute to improved healing, reduced inflammation, enhanced hydration, and greater patient comfort following dermatologic procedures. These characteristics suggest a potential role in reducing downtime and optimizing clinical outcomes.

Further controlled studies are warranted to strengthen the evidence

base and explore the full range of applications of bacterial cellulose in dermatology and aesthetic medicine.

Funding information

Missner company, Blumenau, Brazil.

Conflicts of Interest

Camila Safranski Martins and Dioney Neves are current employees of Missner, and hold stock options in the company. The remaining authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Ganesan O, Kiwanuka H, Hamaguchi R, et al. A review of regenerative medicine and tissue engineering with a focus on wound healing and anti-aging. Front Surg. 2025; 12: 1504563.
2. Mao AS, Mooney DJ. Regenerative medicine: current therapies and future directions. Proc Natl Acad Sci USA. 2015; 112: 14452-14459.
3. Sajjad W, Khan T, Ul-Islam M, et al. Development of modified montmorillonite-bacterial cellulose nanocomposites as a novel substitute for burn skin and tissue regeneration. Carbohydr Polym. 2019; 206: 548-556.
4. Carvalho T, Guedes G, Sousa FL, et al. Latest advances on bacterial cellulose-based materials for wound healing, delivery systems, and tissue engineering. Biotechnol J. 2019; 14: e1900059.
5. Ullah H, Wahid F, Santos HA, et al. Advances in biomedical and pharmaceutical applications of functional bacterial cellulose-based nanocomposites. Carbohydr Polym. 2016; 150: 330-352.
6. Vielreicher M, Kralisch D, Völkl S, et al. Bacterial nanocellulose stimulates mesenchymal stem cell expansion and formation of stable collagen-I networks. Sci Rep. 2018; 8: 9401.
7. Levy T, Lerman I, Waibel J, et al. Expert consensus on clinical recommendations for fractional ablative CO_2 laser in facial skin rejuvenation treatment. Lasers Surg Med. 2025; 57: 15-26.
8. Belletti S, Madeddu F, Brando A, et al. Laser impacts on skin rejuvenation: the use of synergistic emission of CO_2 and 1540 nm wavelengths. Medicina (Kaunas). 2023; 59: 1857.
9. Sherrill JD, Finlay D, Binder RL, et al. Transcriptomic analysis of human skin wound healing and rejuvenation following ablative fractional laser treatment. PLoS One. 2021; 16: e0260095.
10. Sulaeva I, Henniges U, Rosenau T, et al. Bacterial cellulose as a material for wound treatment: properties and modifications. Biotechnol Adv. 2015; 33: 1547-1571.
11. Campano C, Rivero-Buceta V, Hernandez-Arriaga AM, et al. Pushing the limits of bacterial cellulose for biomedicine: a review. Int J Biol Macromol. 2025; 323: 146701.
12. de Amorim JDP, da Silva Junior CJG, de Medeiros ADM, et al. Bacterial cellulose as a versatile biomaterial for wound dressing application. Molecules. 2022; 27: 5580.
13. D AG, Adhikari J, Debnath P, et al. 3D printing of bacterial cellulose for potential wound healing applications. Int J Biol Macromol. 2024; 279: 135213.
14. Perugini P, Bleve M, Redondi R, et al. In vivo evaluation of biocellulose facial masks as active delivery systems. J Cosmet Dermatol. 2020; 19: 725-735.
15. Rajwade JM, Paknikar KM, Kumbhar JV. Applications of bacterial cellulose and its composites in biomedicine. Appl Microbiol Biotechnol. 2015; 99: 2491-2511.
16. Bianchet RT, Vieira Cubas AL, Machado MM, et al. Applicability of bacterial cellulose in cosmetics: bibliometric review. Biotechnol Rep (Amst). 2020; 27: e00502.

© 2026 Laila Klotz de Almeida B, et al. This article is distributed under the terms of the Creative Commons Attribution 4.0 International License