DECEMBER 11-12,2025
۲۱ و ۲۰ آذر ماه ۱۴۰۴
دومین کنگره پلاسما پزشکی ایران
The 2 nd Congress on Plasma Medicine
دبیرخانه دائمی کنگره پلاسما پزشکی ایران
www.plasmamedsym.ir

# Integration of Cold Plasma with Post-Knee-Surgery Rehabilitation: Two-Dimensional Modeling of Dosimetry, Thermal Safety, and Antimicrobial Effect

Fateme Taftish[1*], Mehran Abrumand[2]

[1]Amirkabir University of Technology, Faculty of Physics and Energy Engineering, Nuclear Fusion Group, Tehran, Iran
[2]University of Isfahan, Faculty of Physics, Nuclear Engineering Group, Isfahan, Iran

**OPEN ACCESS**

**Citation:**
Taftish F, Abrumand M. Integration of Cold Plasma with Post-Knee-Surgery ehabilitation: Two-Dimensional Modeling of Dosimetry, Thermal Safety, and Antimicrobial Effect. *Iran Biomed J*. Supplementary (2-2026): 3.



**ABSTRACT**

**Introduction:** Cold atmospheric plasma (CAP), through the generation of reactive oxygen and nitrogen species, can reduce infection at the incision surface and accelerate skin repair. This study, using a two-dimensional reaction–diffusion and heat-conduction model, provides a framework for CAP dosimetry and thermal safety in post-knee-surgery rehabilitation. It allows for the evaluation of microbial reduction and enhancement of epithelialization without exceeding the safe temperature range, providing groundwork for ex vivo and clinical validation.

**Materials and Methods:** The present study developed a two-dimensional finite-difference model to simulate the penetration of reactive species, heat conduction, and microbial-load reduction in the skin around the knee incision. The skin layers were modeled with distinct diffusion coefficients, applying a Dirichlet boundary condition for surface dosage, and a convective-flux boundary for heat transfer. Numerical simulations were performed using reference physiological parameters to evaluate thermal safety (≤33°C) and disinfection efficacy (up to 1.3-log reduction).

**Results and Discussion:** The results showed that reactive species penetrated to a depth of only 0.2 mm, the tissue temperature remained below 33°C, and the microbial load decreased by 0.59 log. A mild increase in dosage and exposure time, while staying within the safety limit, resulted in a microbial load reduction of 1–1.3 log.

**Conclusion:** At safe doses, cold plasma effectively reduces microbial load and facilitates the initiation of rehabilitation. Further ex vivo validation and clinical studies are needed to establish more accurate dose-response curves.

*Keywords:* Cold plasma, Microbial-load reduction, Post-surgical rehabilitation, Surgical wound, Thermal safety

**Corresponding Author:** Fateme Taftish
Amirkabir University of Technology, Faculty of Physics and Energy Engineering, Nuclear Fusion Group, Tehran, Iran; E-mail: f.taftish@gmail.com