Does a miniaturized pulsed electromagnetic field device impact the modulation of pathogenic microbiome dynamics of implant-associated infections?

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Method

Specimens used were miniaturized PEMF devices (Magdent) shaped like a healing abutment (healing cap) for dental implants. The PEMF device consisted of a battery, an electronic component and a coil. Two groups were adopted:

In vitro: It was acquired a biofilm polimicrobial through saliva (5 healthy volunteers) and this was subjected to substrates (pulse and control – non-activated) for early 24h and late 72h at 37*C. The microbiological composition of in vitro biofilms was evaluated by the checkerboard DNA–DNA hybridization technique.

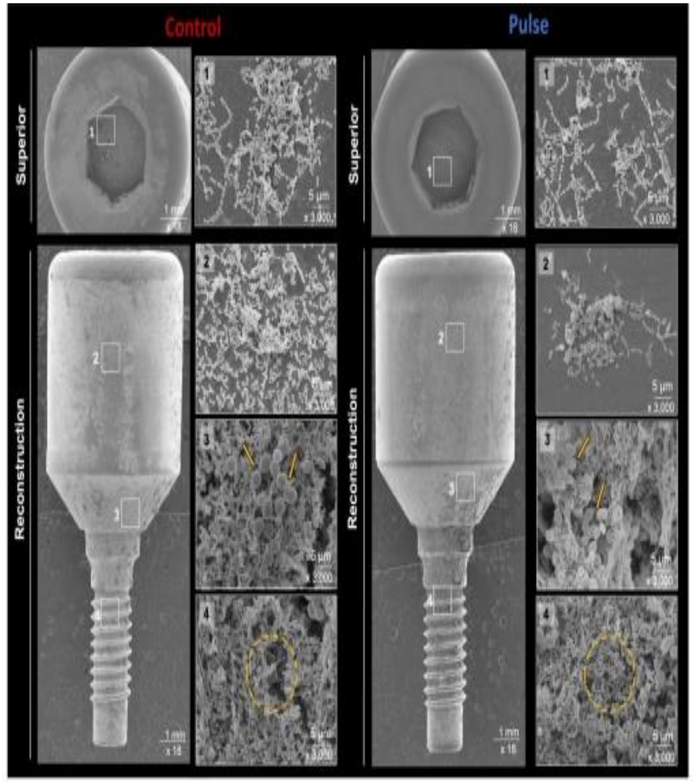
In vivo:The same 5 healthy volunteers each wore a palatal appliance for 3 days. The appliance included one activated PEMF (pulse) and one non-activated (control) device. Following the experimental phase, substrates were immersed in tubes containing TE solution, vortexed and the biofilm suspensions were evaluated using 16S rRNA sequencing to analyze the entire bacterial microbiome composition.

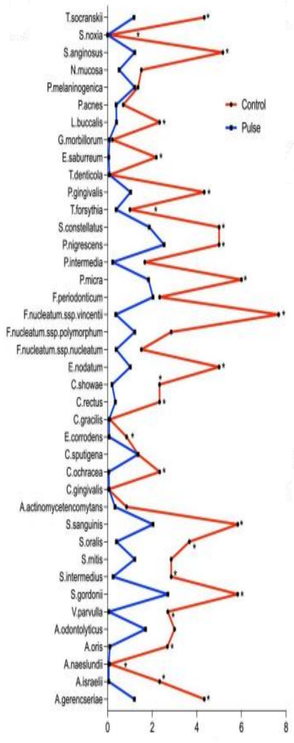
Results

Biological and microbiological outcomes were compared between activated and non-activated PEMF devices.

IN VITRO

In the initial stage (24h) statistically there wasn't difference between the groups, but in bacteria terms there was a 5 x reduction to Fusobacterium periodontium (pulse). In the late stage (72h), PEMF significantly reduced the levels of 25 bacterial species , including putative anaerobic pathogens, such as Porphyromonas gingivalis, Tannerella forsythia, and Treponema socranskii. P. gingivalis, one of the main pathogens associated with tissue damage in oral infections (Chen et al., 2023), showed levels 4 times higher in the control group compared to the pulse group.

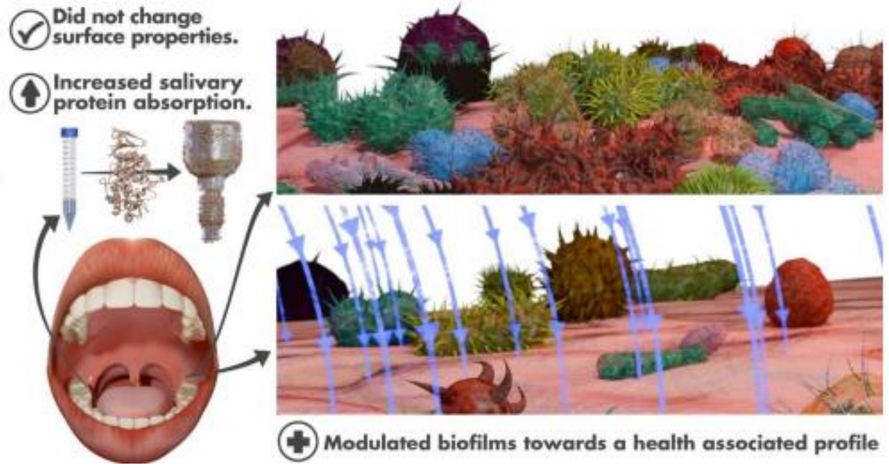


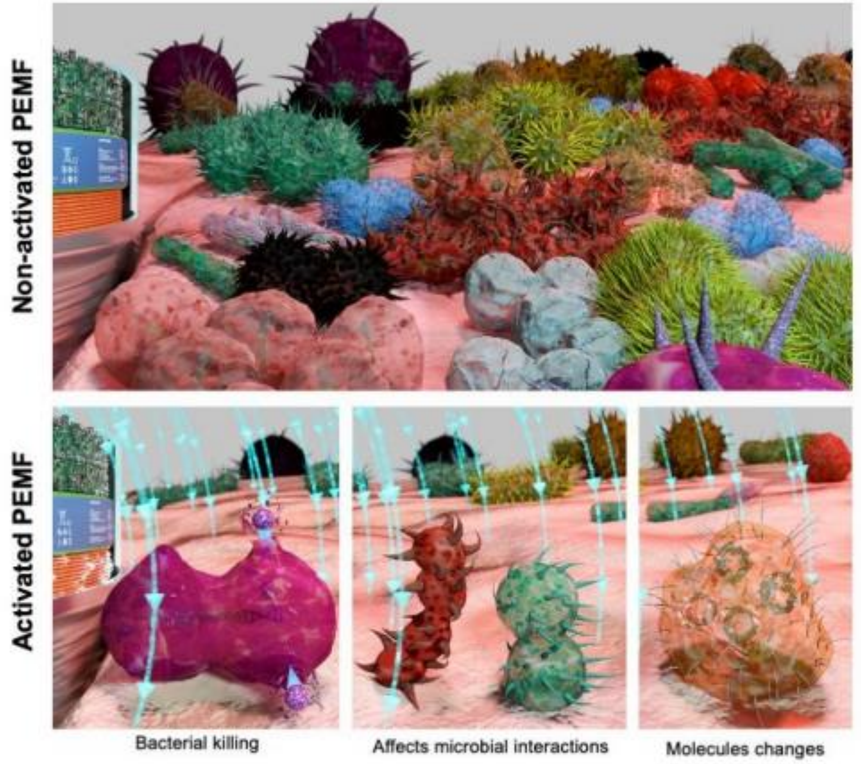


Results

IN VIVO

In vivo model, it was explored the effect of PEMF on modulatng microbial accumulation on the devices inserted in the oral cavity of volunteers, thereby simulating conditions close to clinical settings**.** In terms of the abundant microbial genus found, there was a predominance of Streptococcus, Rothia and Neisseria genus for both groups**.** The abundance of 34 bacterial species increased by at least 5 times in the control group compared with the pulse group, including putative pathogens such as Porphyromonas (HMT-930) and Prevotella (HMT-291) species . Therefore, for late biofilms , PEMF was able to modulate the microbial composition, mainly reducing the levels of important pathogens highly associated with dental implant infections.



Conclusion

PEMF technology successfully suppressed the growth of pivotal putative pathogens related to dental implant infections, while modulating biofilm composition toward a health-associated profile. Importabtly, this was achieved without compromising the surface properties and electrochemical behavior of the device. Therefore, PEMF emerges as a promising and effective strategy for controlling implant-related infections.