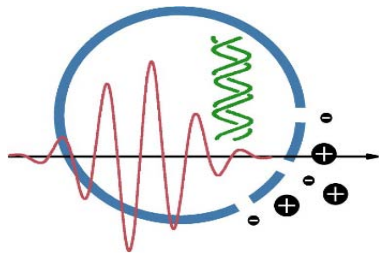


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Old Dominion University**

USE OF NANOSECOND ULTRAHIGH VOLTAGE PULSES FOR WOUND HEALING AND OTHER APPLICATIONS

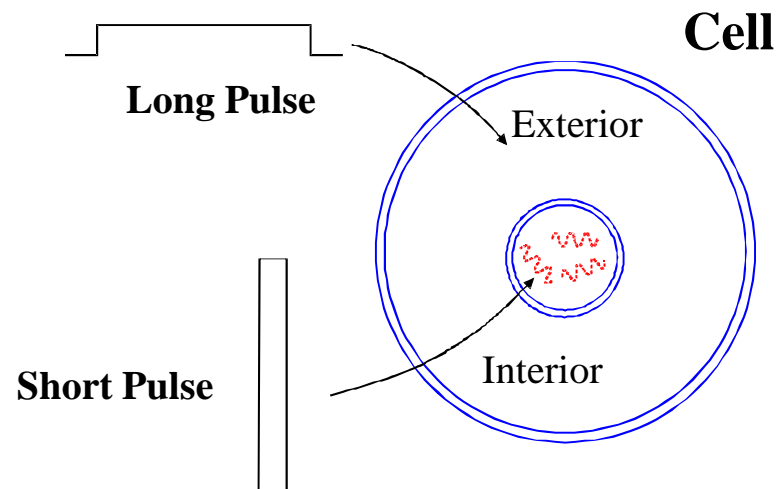
Richard Heller

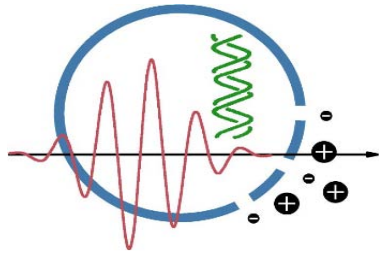


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Pulsed Power: Affect Cell Functions

[from delivery of molecules to release of calcium and induction of apoptosis]

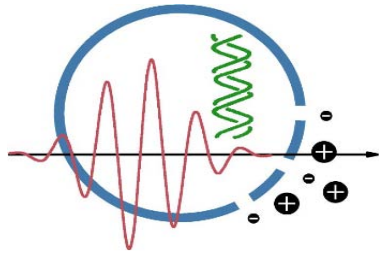




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Wound Healing

- **Inflammatory phase (1-2 days)**
 - Coagulation
 - Migration of inflammatory cells to the wound site
- **Proliferative phase (day 2-day 14)**
 - Migration and proliferation of keratinocytes, fibroblasts and endothelial cells
 - Angiogenesis
 - Granulation tissue formation and re-epithelialization
- **Remodeling phase (day 14-1 year)**
 - Collagen remodeling, scar tissue formation



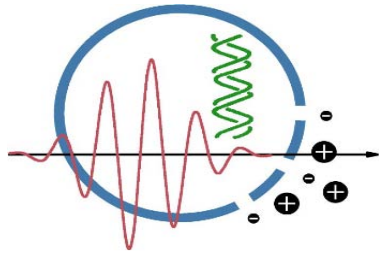
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Platelet Rich Plasma (PRP) – Platelet Gel

PRP – An emerging treatment in a new health sector known as "Orthobiologics." The philosophy is to merge cutting edge technology with the body's natural ability to heal itself.

PRP - Concentrated source of autologous platelets, PRP contains and releases (through degranulation) at least seven different growth factors (cytokines) that stimulate bone and soft tissue healing.

PRP – Can be used to accelerate healing of tendon injuries and osteoarthritis naturally without subjecting the patient to significant risk. The bioactive proteins carried by platelets are currently being used successfully for wound healing in several surgical disciplines including orthopaedic, neurology, otolaryngology, cardiovascular, vascular, general, plastic and reconstructive, pediatrics and in oral surgeries



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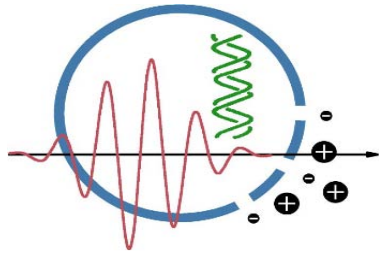
Thrombin is currently used to create PRP

Problems of Using Bovine Thrombin

- possible allergies and complications
- potential risk of contamination of Creutzfeldt-Jakob's disease (Mad-cow disease)
- Immune response
- shortages

Alternatives to Bovine Thrombin

- Human sources
- Recombinant protein



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Alternative to Thrombin

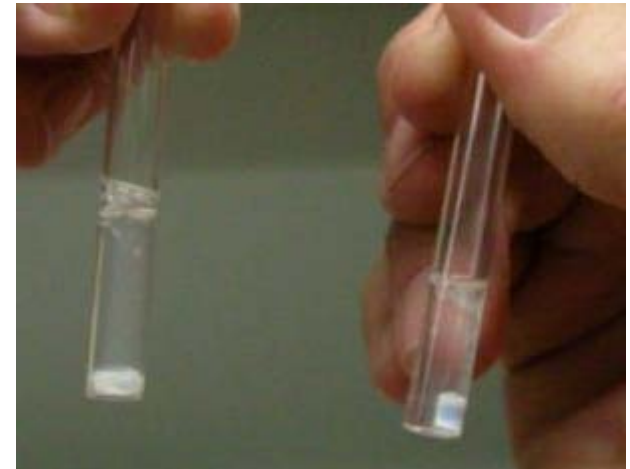
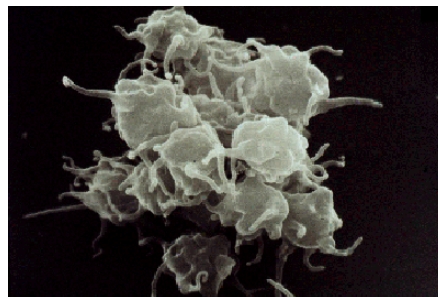
Pulsed electric field (30 kV/cm, 300 ns) can increase intra-cellular Ca^{2+} release and extra-cellular Ca^{2+} influx and produce PRP.

Platelets

Before activation

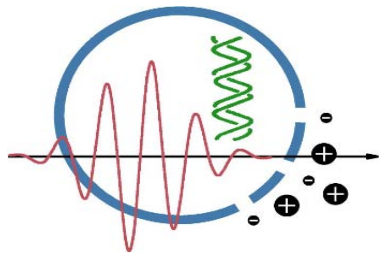


After activation



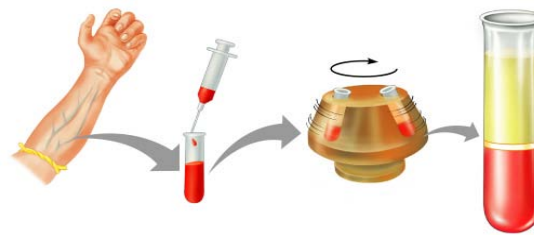
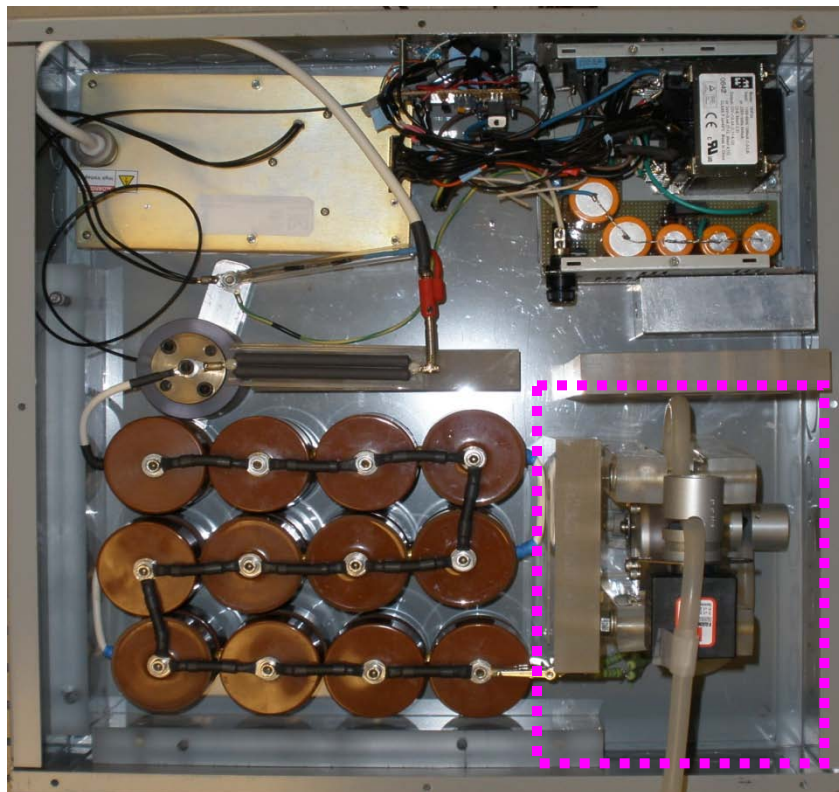
Thrombin
activated gel

nsPEF
activated gel

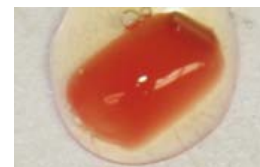
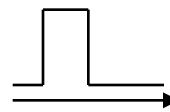


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A Compact Pulsed Power Generator for Platelet Gel Production in Doctor's Office



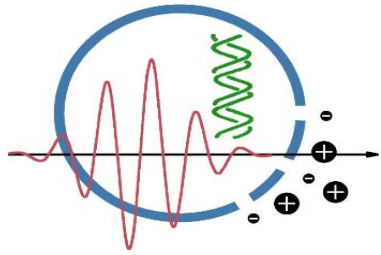
← Platelet Rich Plasma (PRP)



(PRP) Gel

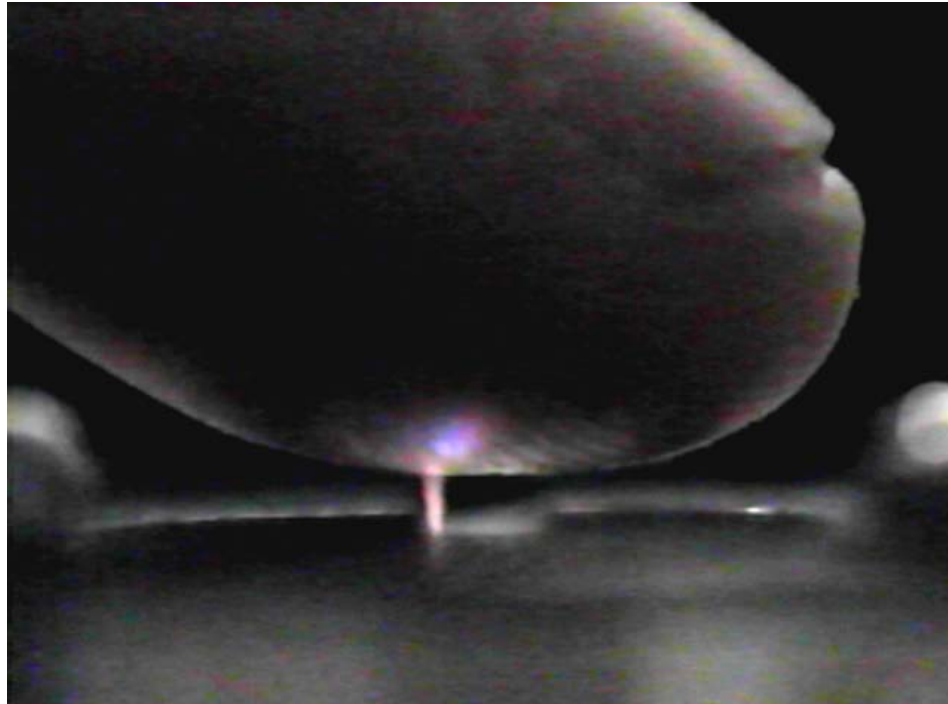


Wound

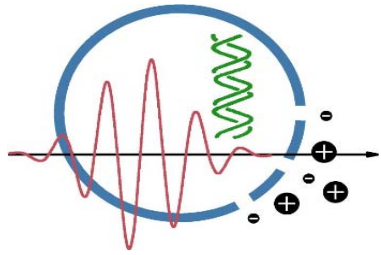


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Cold Plasma Treatment of Biological Agents



room temperature air “plasma”
operated at atmospheric pressure



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Candida can be removed completely in the treated area.

sham (not treated)



microjet treatment
10 mm distance

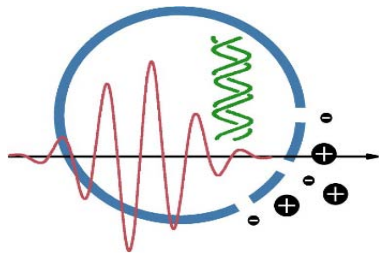


(cold) air treatment



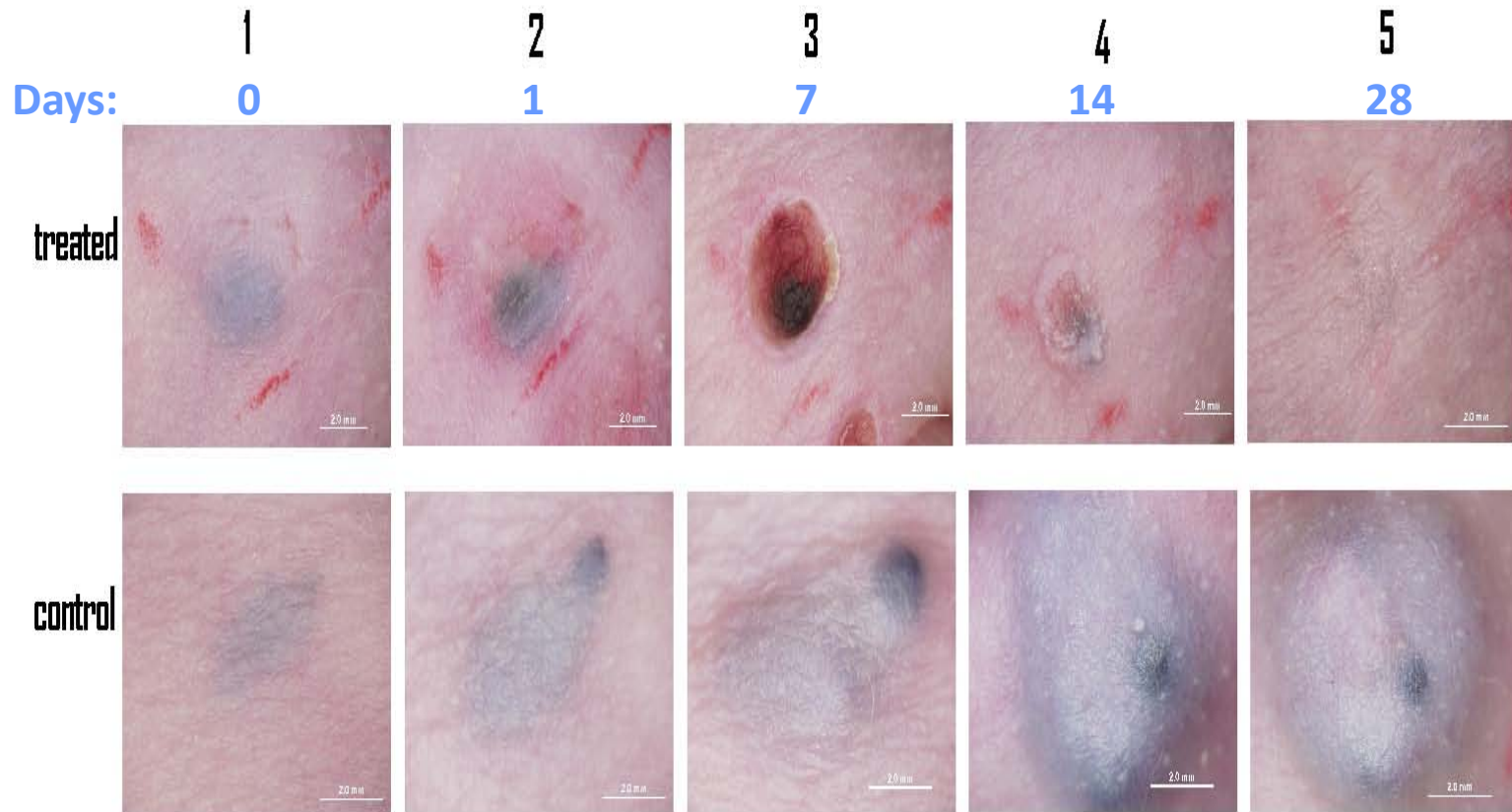
A single treatment results in a complete removal of colony forming units.

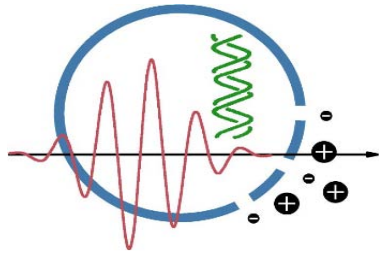
Pre-treatment of the agar-plates with the jet has no effect.



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NsPEFs Decrease B16F10 Tumor Size





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Commercial Applications – Instrumentation and Protocol/therapy development

Wound Healing

Plasma Rich Platelets

Cold Plasma – disinfect

Gene Therapy – angiogenesis

Cancer Therapy

nsPEF – ablation

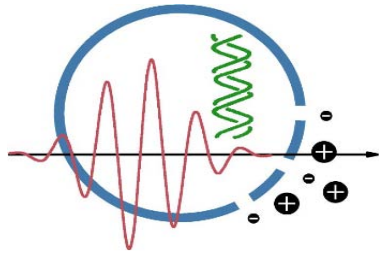
Gene therapy- immunotherapy

Cardiovascular

Coronary artery disease – gene therapy to assist revascularization

Peripheral vascular disease - gene therapy to assist revascularization

Environmental applications



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Collaboration Opportunities

Licensing and CRADA opportunities:

PRP Technology

nsPEF ablation technology

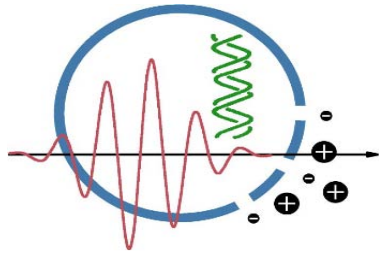
Gene transfer methods, electrodes and instrumentation

Cold Plasma

Disinfection

Environmental

New applications for technologies



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<http://www.odu.edu/engr/bioelectrics/>