SynEnergy for faster wound healing
THE FUNDAMENTALS

The PlasmaDerm® family

PlasmaDerm® Flex
is an innovative device for treating wounds with plasma. It improves wound healing in chronic and poorly healing wounds, thus simplifying wound management. It can also be used in all other wounds to prevent impaired wound healing.

PlasmaDerm® Dress
is an innovative dressing based on the same active principle. It is used, e.g. to prevent postoperative wound healing. PlasmaDerm® Dress is applied to the area of the operation or the fresh wound and then secured with other bandages. The dressing remains in place and plasma can be applied to it daily.

What is plasma?

The fourth state of matter
Plasma is the fourth state of matter after solid, liquid and gaseous. It arises when additional energy is added to a gas, for example in the form of heat.

More common than you think
Plasma and its use can be found everywhere in our environment:
- In nature, e.g. in the form of lightning, the northern lights and the sun
- In technology, e.g. in energy-saving light bulbs, plasma televisions or for the pretreatment and finishing of surfaces
- In biomedicine, e.g. for the optimization of biorelevant surfaces, the inactivation of micro-organisms or to arrest bleeding

Plasma is not all the same
The consistency of plasma is affected by the temperature, the electromagnetic field, the pressure, the gas and the discharge geometry.

PlasmaDerm®: innovative wound treatment with the fourth state of matter
**THE SPECIAL TECHNOLOGY**

**What is di_CAP®?**

PlasmaDerm® generates cold plasma by means of dielectric barrier discharge (DBD). For this, the skin functions as the opposite pole. The plasma is generated directly on the skin with the surrounding air.

_plasmaDerm®- spacer / applicator_

_di_CAP®_

The special feature is the generation of stimulating, high-frequency electric fields by di_CAP®. This is the key to a unique technology.

Activated gas species: Ozone, oxygen

Stimulating high-frequency electric fields

UV-A- and UV-B-light

The special generation of plasma using the skin gives rise to UVA and UVB light as well as various activated gas species such as ozone and oxygen.

Cold plasma is created under normal ambient conditions at atmospheric pressure and low temperatures that do not irritate the skin.

**di_CAP®: The skin functions as the opposite pole.**  
**The cold plasma is formed directly on the skin.**

**The innovation**

The innovation in PlasmaDerm® consists of the unique technology with which the plasma is made usable for treating the skin: di_CAP®, in which the skin is part of forming plasma.

**di_CAP®: The skin is the opposite pole – direct approach with 3 physical effects**
THE MODE OF ACTION

What does di_CAP® do?

1st effect: antimicrobial
Kills micro-organisms, for instance with UV light and ozone. Antimicrobial even against multidrug resistant bacteria with no development of resistance

2nd effect: activates microcirculation
Increases microcirculation with the stimulating, high-frequency electric fields that are formed through the unique generation of plasma using the skin

The improved oxygen saturation in the tissue leads to
- Optimized cell migration\(^1,3\)
- Increased collagen synthesis\(^1,3\)
- Proliferation of fibroblasts\(^2,4,6\)
- Faster epithelialization\(^1,2,3\)

di_CAP®: double action

double clinical benefit
VARIOUS INDICATIONS

When is PlasmaDerm® used?

When wound management reaches its limits
Poorly healing wounds are a common problem in clinical routine. They can cause various difficulties:
- Time-wise: long-term wound care
- Financial: hospital stays, dressing material, personnel, etc.
- Emotional: pain, loss of independence, etc. for the patient

Thanks to its dual action, PlasmaDerm® results in faster wound healing and is thus an effective complement to wound management.

Effective, improved wound management for poorly healing wounds

Case studies with improved wound healing

**Diabetic foot syndrome**

Patient | male | age 66
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- Underlying condition: diabetic foot ulcer
- Treatment period: 9 weeks
- Number of treatments carried out: 26
- Treatment was given without antibiotics

Considerable reduction of wound size. Pain intensity lowered: from 4 (NRS1) to 1-2 (NRS1) during dressing changes.

**Ulcus Cruris**

Patient | male | age 54
---|---|---
- Underlying condition: Peripheral arterial occlusive disease
- Concomitant diseases: heart failure, COPD, alcohol abuse, psoriasis vulgaris
- Treatment period: 13 weeks
- Number of treatments carried out: 28

PlasmaDerm® has a very positive effect on the course of the wound even in multimorbid patients.

**Dekubitus**

Patient | female | age 55
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- Concomitant conditions: long-term care, pressure ulcers necessitating a stoma
- Wound present for: several years
- Number of treatments carried out: 30
- Treatment period: 11 weeks
- Number of treatments carried out: 30

Closure of decubitus ulcer that was present for many years with PlasmaDerm® treatment.
USE IN CLINICS

PlasmaDerm® in surgery and prevention

Wound healing always has risks
Uncomplicated wound healing depends on several factors. The Commission for Hygiene and Infection Prevention at the Robert Koch Institute describes the following risk factors for postoperative wound healing:
- Inadequate antibiotic prophylaxis
- Hypoxia / insufficient oxygenation of the wound
- Inadequate wound care

Case studies with improved wound healing

Peri- and postoperative use

Patient | male | age > 80
- Procedure: bi-mammary bypass, status post surgery
- Concomitant conditions: diabetes mellitus, obesity, peripheral arterial occlusive disease
- Treatment period: 10 days
- Number of treatments carried out: 1+7 (intra-operative and inpatient care)

PlasmaDerm® supports non-irritated scar tissue.

Postoperative poor wound healing

Patient | male | age 28
- Procedure: reimplantation of total hip replacement and coverage with a free latissimus dorsi flap. Livid discoloration after surgery, haematoma and venous congestion
- Underlying condition: gunshot wound, total hip replacement → Infection → removal
- Treatment period: 1 week
- Number of treatments carried out: 4

The wound situation was relieved with just a few PlasmaDerm® treatments.

Postoperative wound healing disorder

Patient | male | age 64
- Procedure: Promotion of postoperative wound healing (split-wound application)
- Underlying condition: donor-site wound radial artery graft
- Treatment period: 4 weeks
- Number of treatments carried out: 4

Faster wound healing in direct comparison.

Useful complement for peri- and postoperative wound management
USE

PlasmaDerm® di_CAP® product line

1. Product selection
   - **PlasmaDerm® Flex**
     - Flex device with manual applicator
     - Flex spacer/applicator
   - **PlasmaDerm® Dress**
     - Dress device
     - Dress dressing

   No additional contamination due to sterile single-use applicator

2. Check wound coverage & size
   - **PlasmaDerm® Flex**
     - 27.5 cm² area under the spacer
     - More than one can be applied with slight overlap
   - **PlasmaDerm® Dress**
     - 100 cm² area under the spacer
     - Remains in the same position under the dressing

   Can be used to cover large wounds

3. Application
   - **PlasmaDerm® Flex**
     - Unwrap the spacer in sterile conditions
     - Place on the manual applicator
     - Place on the wound
     - Device can be operated with one hand
     - Apply only 90 sec. per area

   **PlasmaDerm® Dress**
     - Unwrap Dress under sterile conditions
     - Place on the wound
     - Apply a dressing
     - For treatment: Connect device and apply for 90 sec.
     - Dress may remain under the dressing for several days
     - Dress may be applied at any time without changing the dressing

   Fast, uncomplicated handling

4. Treatment recommendation
   - Exudation
   - Granulation
   - Epithelialization

   5 times a week in the initial phase
   2 to 3 times a week during granulation
   Additional applications during epithelialization

   All PlasmaDerm® products support all phases of wound healing and can also be used in combination.

Easy to integrate into wound care due to fast, reliable application
Sources:

1. Cold Atmospheric Plasma (CAP) Changes Gene Expression of Key Molecules of the Wound Healing Machinery and Improves Wound Healing In Vitro and In Vivo, Arndt S. et al., 2013, PLoS ONE

2. Non-thermal Plasma Suppresses Bacterial Colonization on Skin Wound and Promotes Wound Healing in Mice; Ying Y. et al., 2011, Huazhong University of Science and Technology and Springer-Verlag Berlin Heidelberg

3. Non-thermal dielectric barrier discharge plasma induces angiogenesis through reactive oxygen species; Arjunan K. P. et al., 2011, J. R. Soc. Interface


5. Cold plasma on full-thickness cutaneous wound accelerates healing through promoting inflammation, re-epithelialization and wound contraction; Nasruddin N. et al. 2014, Clinical Plasma Medicine

6. Dr. Ing. Peter Muranyi, Fraunhofer-Institut für Verfahrenstechnik und Verpackung IVV

ALL BENEFITS AT A GLANCE

PlasmaDerm® for faster wound healing

Plasma application to the skin—with the unique di_CAP®

Combination of three synergistic effects
- Stimulating high-frequency electric fields
- UVA and UVB light
- Activated gas species – incl. ozone, oxygen

Double action
- Antimicrobial even against multidrug resistant bacteria
- Increases microcirculation and promotes wound healing

Proven in studies.

effective • easy • safe

Easier wound care for more satisfied patients
- Easy to use
- Can be used after brief training
- Mobile use possible
- Convenient, can also be operated by patients
- Bigger areas of wounds treatable
- Effect measurable up to 8 mm deep

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