the
art of
shock
wave

DUOLITH® SD1 »ultra«

Shock wave therapy for dermatological applications

STORZ MEDICAL

STORZ MEDICAL AG

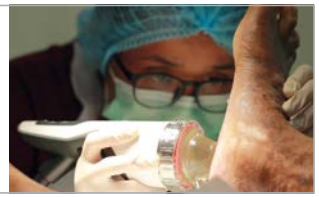
Established in 1987, STORZ MEDICAL AG is an independent partner company of the KARL STORZ Group. The aim of our physicists and engineers is continuing advancement of shock wave technology, the creation of new system concepts and the addition of new indications in close co-operation with leading medical institutes.

Our products have proved to be highly effective in millions of urology treatments and are now opening up the benefits of non-invasive technology to other medical disciplines. Unique pioneering work, such as the invention of the electromagnetic cylindrical source, forms the basis for STORZ MEDICAL's extensive range of products and services in the field of shock wave technology.

What are shock waves?

Shock waves are audible high-energy sound waves. In the medical world, shock waves have been used successfully for the treatment of various medical conditions since around 1980. Originally only used for the disintegration of kidney stones, shock wave therapy has evolved into a recognized treatment modality in urology, orthopaedics and cardiology, as well as for tissue regeneration in the treatment of dermatological disorders. Shock wave therapy is a non-invasive treatment option. This means that the shock waves are generated outside of the body (extracorporeally) in a handpiece and then travel through the patient's skin into the tissue. Depending on the indication, low-energy shock waves (tissue simulation) or high-energy shock waves (lithotripsy) are applied. Shock waves not only stimulate blood circulation but also induce the formation of new capillary blood vessels (angiogenesis). Most importantly, shock waves enhance the release of eNOS (endothelial nitric oxide synthase) and VEGF (vascular endothelial growth factor).

05 I Shock waves induce healing processes



09 I Touch screen

13 I Accelerated healing of burns and open wounds

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Shock waves induce healing processes

Focused shock waves create considerable tension in the tissue due to a sudden major increase in pressure. Receptors that monitor tissue integrity are subject to suprathreshold stimulation when exposed to shear, compressive and tensile forces (mechanotransduction). As a result, receptors stimulated in this manner trigger a reactive adaptation that affects the tissue's characteristics.[1]

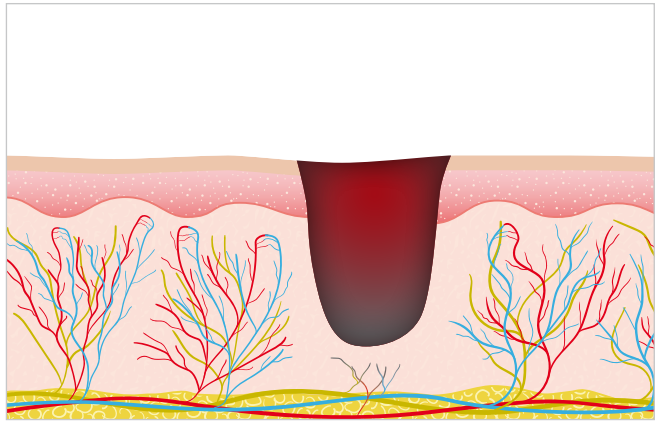
Mechanotransduction induces biochemical processes that stimulate cell permeability and enhance metabolic activity. In addition, messenger substances and growth factors are released, which improve the blood supply to the tissue[2] and increase cell regeneration via gene expression and stem cell activation.[3] This results in new tissue regeneration, structural improvement of the collagen fibre network[4] and angiogenesis[5]. Modulating effects of shock waves on pro-inflammatory and anti-inflammatory cytokines such as interleukin-10 and TNF-alpha have also been observed.[6]

Highlights

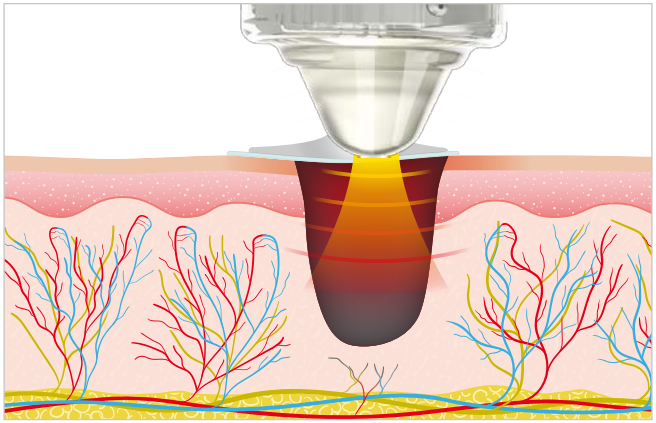
- Stimulation of cell permeability
- Improved blood supply to the tissue through eNOS release
- Release of growth factors (e.g. VEGF)
- Enhanced cell regeneration through stem cell activation
- Antibacterial and anti-inflammatory effect
- Improved blood circulation through angiogenesis

[1] Huang, C. et al.: Trends in Molecular Medicine, 19(9):555-564, 2013.
[2] Ha, C. H. et al.: International Journal of Cardiology, 168(4):4168-4177, 2013.
[3] Weihs, A. M. et al.: Journal of Biological Chemistry, 289(39):27090-27104, 2014.
[4] Notarnicola, A.: Muscles, Ligaments and Tendons Journal, 2(1):33-37, 2012.
[5] Mittermayr, R. et al.: Annals of Surgery, 253(5):1024-1032, 2011.
[6] Moretti, B. et al.: BMC Musculoskeletal Disorders, 9(1):16, 2008.

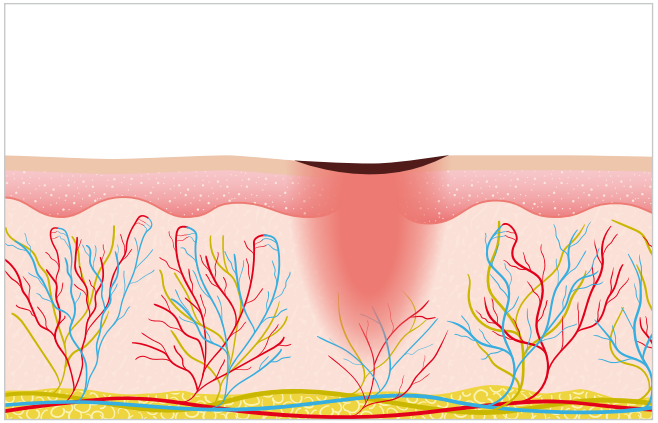
Schematic:
Non-healing wound with impaired angiogenesis



Schematic:
Focused shock wave treatment of a non-healing wound



Schematic:
Extracorporeal Shock Wave Therapy stimulates angiogenesis




0.25
SHARP MEDICAL

Focused shock wave therapy with C-ACTOR® handpiece

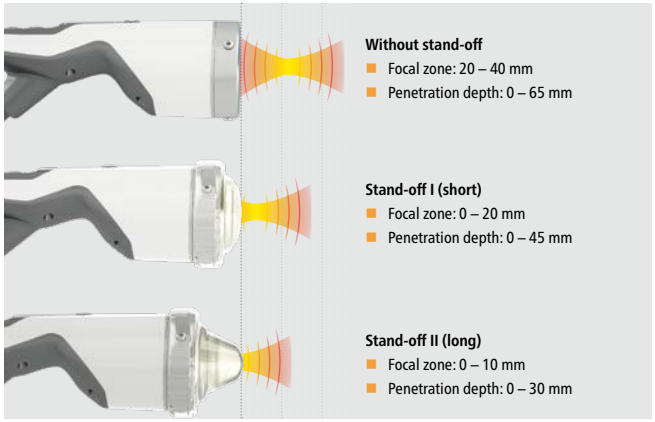
The DUOLITH® SD1 »ultra« boasts intuitive operation, an ergonomic handpiece and high-quality design. All essential treatment parameters (intensity/frequency) can be selected by using the buttons provided directly on the handpiece and are shown in the handpiece display. This enables users to fully focus on the treatment zone in order to achieve a successful treatment outcome.

The C-ACTOR® handpiece is specially designed for near-surface treatments, making it ideal for use in dermatology and especially in wound healing. The electromagnetically generated shock waves are characterized by a constant energy level. Their focal zone can be adjusted by using different stand-offs to ensure safe and effective treatment of the target tissue.

Highlights

- C-ACTOR® handpiece specially designed for near-surface treatments
- Intensity and frequency control directly on the handpiece
- Different stand-offs to adjust the focal zone penetration depth (0 – 65 mm)
- Constant energy level (0.03 – 1.24 mJ/mm²)

Stand-offs for different penetration depths



Maria Chiara Vulpiani
Orthopaedic and Traumatology Specialist, Associate Professor Physical Medicine and Rehabilitation, Sapienza University, School of Medicine, Rome, Italy

“Chronic soft tissue wounds of the lower limbs are debilitating, painful and often unresponsive to advanced dressing treatments. ESWT represents a non-invasive strategy for difficult-to-treat soft tissue wounds of the lower limbs. The rationale for the use of ESWT is stimulation of tissue healing, especially with respect to angiogenesis, anti-inflammatory responses and the tissue regeneration.”


Wound Healing
Patients
Visual Analogue Scale
C-ACTOR
0.25
Energy (mJ/mm²)
1500
Shocks
6
Frequency (Hz)
0
Total shocks
0.000
Total energy (J)
Wound Healing
2022/04/06 12:30
Dermatology Clinic
90%
Settings
Info
Visible Body

Touch screen – The ideal add-on to the DUOLITH® SD1 T-TOP »ultra«

The optional 10" touch screen is connected with the shock wave system via a USB cable to provide valuable add-on features. Besides the additional device control, the touch screen offers patient management functionalities as well as treatment parameters recommended by experienced users and supported by images. These data and parameters can be retrieved and applied when required. The integrated Visible Body® software enables detailed visualization of muscular structures and offers a detailed inside look deep down at the macroscopic and microscopic levels of the human body. Detailed definitions and in-depth anatomical information provide additional user support. Rotating and moving 3D models allow visualization of the vascular and lymphatic systems, muscle movements and pathologies. This enables unprecedented interaction between the user and the patient.

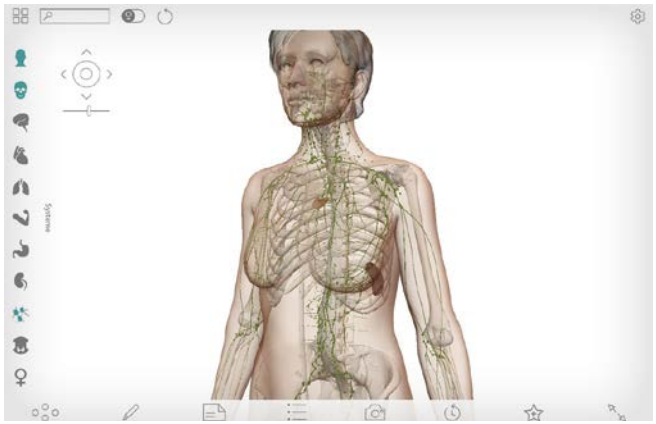
Highlights

- 10" touch screen (optional)
- Patient management system with treatment history
- Image-based treatment parameters
- Visible Body® digital anatomy atlas: macroscopic and microscopic 3D anatomy models

Touch screen – Treatment parameters with images

Touch screen – Treatment example: wound healing

Visible Body® – Overview of the lymphatic system



Shock wave therapy for chronic wounds

Underlying diabetic diseases are often accompanied by chronic skin lesions. These wounds, caused by a poor blood supply and by disturbed regeneration processes, are difficult to treat and represent a major challenge in therapeutic wound management.

Several studies have shown that Extracorporeal Shock Wave Therapy (ESWT) significantly reduces healing times, improves and accelerates wound closure and achieves better functionality in the restored tissue.[7,8,9]

A review of randomized controlled trials revealed an almost doubled healing rate and an approximately 30% reduction in wound area when ESWT was used in addition to standard wound treatment. Moreover, the healing process was shortened by almost 3 weeks.[10] None of the studies reported any side effects or complications.

Shock waves not only stimulate blood circulation but also induce the formation of new capillary blood vessels[11]. This is confirmed by the release of eNOS and VEGF proteins during shock wave therapy, whose metabolic effect enhances vascularization and thus wound closure[12]. In addition, a strong antibacterial[13] and anti-inflammatory effect[14] is observed as a result of ESWT.

[7] Jeppesen, S. M. et al.: Journal of Wound Care, 25(11):641-649, 2016.
[8] Moretti, B. et al.: BMC Musculoskeletal Disorders, 10:54, 2009.
[9] Omar, M. T. et al.: Diabetes Research and Clinical Practice, 106(3):548-554, 2014.
[10] Zhang, Li et al.: Wound Repair and Regeneration, 25(4):697-706, 2017.
[11] Mittermayr, R. et al.: Annals of Surgery, 253(5):1024-1032, 2011.
[12] Hayashi, D. et al.: Wound Repair and Regeneration, 20(6):887-895, 2012.
[13] Gerdesmeyer, L. et al.: Ultrasound in medicine and biology, 31(1):115-119, 2005.
[14] Moretti, B. et al.: BMC Musculoskeletal Disorders, 9(1):16, 2008.

Case study: Diabetic foot ulcer

- 55-year-old male patient, diabetes mellitus for over 7 years
- Non-healing ulcer for one year, medication for 8 months
- 3 treatments in 3 weeks

Source: Dr Angela Notarnicola, Az. Osp. Universitaria Consorziale Policlinico, Bari, Italy

Case study: Diabetic neuropathic ulcer

- 70-year-old male patient
- Non-healing ulcer for 2 years
- 10 treatments in 10 weeks

Source: Dr Henning Lohse-Busch, Rheintalklinik, Bad Krozingen, Germany

Accelerated healing of burns and open wounds

In the treatment of burns and open wounds, it is important that the individual wound healing stages are initiated and completed as quickly as possible without disruptions. Initial wound closure and degradation of the damaged tissue are key to tissue regeneration and the repair of the extracellular matrix[15].

ESWT triggers a variety of mechanisms and clinical effects. The anti-inflammatory effect during the first wound healing stage is of particular importance.[16] It plays a key role in ensuring that wound closure progresses smoothly, especially following burns.[17] The influence of ESWT on the initial inflammatory reaction has been demonstrated in both interleukin expression[18] and macrophage activity.[19]

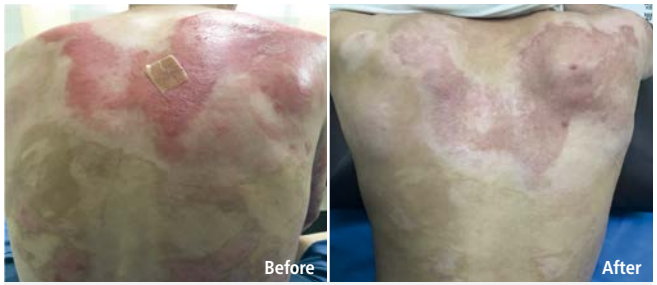
The use of ESWT from as early a stage as possible leads to a marked acceleration of the healing process and a significant reduction in the time to re-epithelialization[20].

Angiogenesis and the associated blood supply to the tissue[21], in conjunction with the release of eNOS and VEGF[22] during the granulation stage, lead to progressive wound closure. This effect was found even in deep wound injuries.

In principle, shock wave therapy can be performed easily and largely without side effects at any stage of wound healing. For open wounds, the use of a sterile cover is recommended for hygienic reasons.

[15] Xue, M. et al.: Advances in Wound Care (New Rochelle), 4(3):119-136, 2015.
[16] Mittermayr, R. et al.: Wound Repair and Regeneration, 20(4):456-465, 2012.
[17] Davis, T. A. et al.: International Wound Journal, 6(1):11-21, 2009.
[18] Moretti, B. et al.: BMC Musculoskeletal Disorders, 9(1):16, 2008.
[19] Sukubo, N. G. et al.: International Journal of Surgery, 24:124-130, 2015.
[20] Mittermayr, R. et al.: Wound Repair and Regeneration, 20(4):456-465, 2012.
[21] Mittermayr, R. et al.: Annals of Surgery, 253(5):1024-1032, 2011.
[22] Hayashi, D. et al.: Wound Repair and Regeneration, 20(6):887-895, 2012.

Case study: Skin burns



- 34-year-old male patient
- 1 treatment per week for one year

Source: Dr Cheong Hoon Seo, Dr Yoon Soo Cho, Dr So Young Joo, Hallym University Hangang Sacred Heart Hospital, College of Medicine, Hallym University, Seoul, South Korea

Case study: Open wound

- 55-year-old female patient
- 11 treatments in 6 weeks

Source: Dr Zamir Afridi, Dr Ziaullah, Storz Shockwave Clinic in Peshawar, Pakistan

Reduction and improvement of lymphoedema

Lymphoedema is a congenital malformation or chronic disease of the lymphatic system resulting from damage to the lymphatic capillaries, lymph nodes and lymph flow pathways.[23] As a result, the progression of this condition is characterized by functional and structural tissue changes, which are accompanied by an increase in connective and fatty tissue.[24]

Of the complications that can occur after breast cancer surgery, lymphoedema is among the most common.[25] Preclinical studies have shown that Extracorporeal Shock Wave Therapy, in addition to angiogenesis, also stimulates the formation and growth of lymphatic vessels and leads to an overall attenuation of the oedema.[26,27]

Consequently, clinical studies have confirmed that the application of shock waves has a significant effect on volume reduction and skin thickness.[28] The majority of patients felt that the tissue in the affected extremities was softer after treatment, and they reported improved sensory function and perceived a significant reduction in pain.[29]

[23] S2k Leitlinie: Diagnostik und Therapie der Lymphödeme AWMF Reg.-Nr. 058-001, 2017.
[24] Liu, N. F. et al.: Lymphology, 31(4):173-179, 1998.
[25] Miccinilli, S. et al.: Lymphology, 53(3):118-135, 2020.
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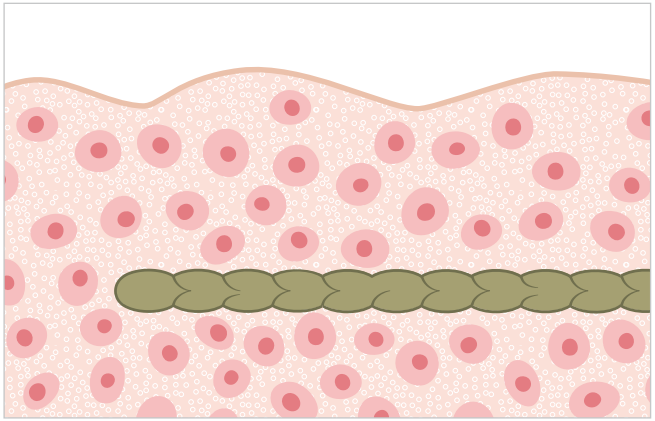
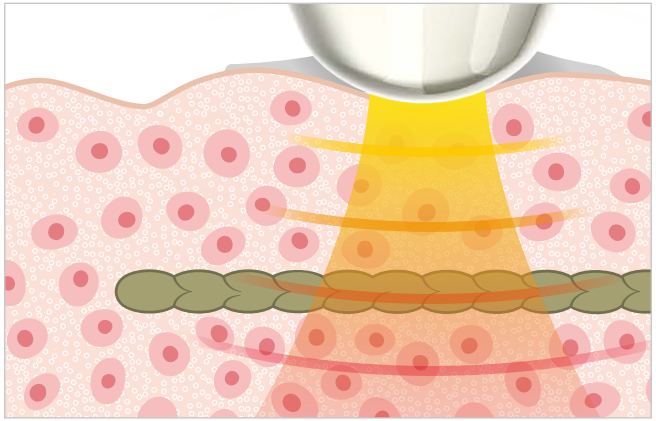
[27] Serizawa, F. et al.: European Journal of Vascular & Endovascular Surgery, 42(2):254-260, 2011.
[28] Lee K. W. et al.: Annals of Rehabilitation Medicine, 44(5):386-392, 2020.
[29] Bae, H. et al.: Annals of Rehabilitation Medicine, 37(2):229-34, 2013.

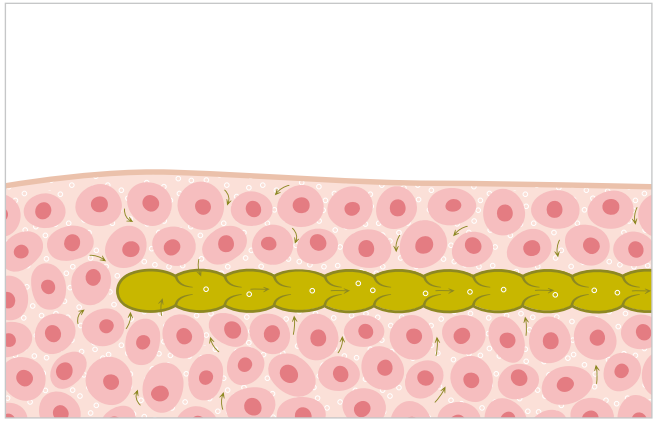
Schematic:
Lymphoedema, disturbed lymph flow



Schematic:
Shock wave treatment of lymphoedema



Schematic:
Normal lymph drainage



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