In 2004, Mattioli Engineering introduced a new concept in dermatology for the transdermal delivery of high-molecular-weight therapeutics up to 1,000 kDa. The patented, proprietary technology, known as Dermoelectroporation® (DEP) is shown in Figure 1 and 2. The DEP system delivers controlled current pulses between two adjacent electrodes to increase the permeability of the skin. The effect of the electrical pulses is the opening of water-based microchannels through stratum corneum and epidermis.

Thus a high-molecular-weight drug filled into two adjacent gauze-pad electrodes is then delivered into the dermis. Sonic technology is also employed to enhance delivery.

The device is covered by a broad US patent estate, which includes US patent numbers: 6518538; 6535761; 6587730; 6687537; 6743215; 6748266; 6980854; 7010343; 7083580; 7376460; 7471979; 7496401; 7520875; 7532926; and 7945321.

The device is EU CE marked and US FDA-cleared for the transdermal delivery of lidocaine. Many other drugs are successfully deliverable, although not yet FDA-approved. These include: Botulinum toxin, phosphatidylcholine, aminophylline, L-carnitine, amino acids, heparin, collagen, various vitamins, various steroids, diclofenac and others.

To date, the technology has been used mainly in cosmetic dermatology for delivering subcutaneous.
stances like non-crosslinked hyaluronic acid, in conjunction with a microdermabrasion treat-
ment. The microdermabrasion treatment is a standard in cosmetic dermatology and it is need-
ed in order to have the assurance that the stratum corneum has a maximum permeability so that
that the drug is really transdermally delivered.

The DEP technology developed by Mattioli is an improvement on the standard electropora-
tion pulse systems that have been in use for more than a decade and are known to be able
to deliver macromolecules through stratum corneum and epidermis.

Instead of using the standard electroporation high-voltage controlled pulses, that could dam-
age the skin due to the unpredictable current density, DEP applies controlled current pulses
to the skin. This technology works perfectly if the permeability of the stratum corneum is
enough to enable transdermal transport.

In dermatology it is normal practice to use microdermabrasion in order to pretreat the skin
for further treatment and thus has not been a problem to introduce this limitation also because
Mattioli is one of the major manufacturers of microdermabrasion equipment. The reason pre-
treatment is included is that we limit to 100V the maximum voltage that the device applies to the
skin, in order to avoid adverse effects.

Recently, in order to broaden the use of the technology, a means to verify sufficient stratum
corneum permeability has been added to the equipment. This is done by measuring the elec-
trical impedance of the skin during the current pulse. This makes it possible to check if pretreat-
ment is needed and, further, to judge whether full microdermabrasion pretreatment is required
or whether simpler pretreatment using scrubs or even gently abrasive paper would suffice.

The DEP comprises a machine body and a handpiece. On the handpiece is mounted
an optional computerised liquid dispenser that delivers the drug to the disposable cap by pushing a disposable drug-loaded syringe (see Figure 3).

Two sizes of syringes (10 cm$^3$ and 20 cm$^3$) and

handpiece sizes (small and large) are avail-
able. The typical injection speed over a skin
surface of 30 cm$^2$ is between 0.5-1 cm$^3$/min,
depending on drug and handpiece size.

The device has been validated in a number
of clinical studies conducted by the Department
of Anatomy at the University of Florence, Italy.
Amongst the many studies that have used the
device, some of the most significant include:

New Transderm® Ionto DEP System

The only and Real transportable Needles free Syringe for any skin need.

The new improved Transderm® Ionto DEP System represents the only one and real transportable “Needles free Syringe” System on the market carrying Dermoelectroporation® technology*.

The new improved Transderm® Ionto DEP System introduces:

- A New “Syringe like” handpiece design for medical controlled transdermal delivery of any ionic drug solution doctors indicate.
- Optimized MACRO molecules transdermal delivery (up to 2,000,000 dalton-type a botulinum toxin** included).
- Continuous Visual indication on the skin absorption.
- Real time control on the whole treatment (delivery time, volume, flow, skin absorption).

New Delivery caps:

- 30% efficiency enhanced
- Faster than ever
- Avoids unwanted waste of products
- More comfort during session

* Dermoelectroporation® is a patented technology from Mattioli Engineering clinically proven to be able to transdermally deliver an accurate dosage of high molecular weight drugs into the body due to controlled electrical pulses.

CAUTION: Federal law (USA) restricts this medical device to sale by or on order of a physician.

** Transdermal delivery of Clostridium botulinum toxin type A by pulsed current iontophoresis
S. Panni M.D., M. Gulisano M.D., T. Poni PhD.,
Department of Anatomy, Histology and Forensic Medicine, Viale Morgagni 52, University of Ferrara, 44124 Ferrara, Italy
M. Ruggiero M.D.,
Department of Experimental Pathology and Oncology, Viale Morgagni 85, University of Ferrara, 44124 Ferrara, Italy

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