

# Transdermal Transport of a Different Size FITC-dextran using Laser Energy - Results of *in Vitro* Experiments

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## SUMMARY

Many advantages of transdermal drug delivery have led to investigation into a range of methods that are capable of overcoming the considerable barrier properties of the skin. Different physical enhancement methods are used for this purpose, one of them being the use of fractional lasers to create transport pathways in the stratum corneum and enhance transdermal delivery of drugs [1, 2]. The aim of the study was to demonstrate *in vitro* that different types and energies of laser pulses greatly influence transdermal transport of FITC-dextran through pigs' ear skin. Vertical glass Franz diffusion cells were used to study molecular transport through excised and dermatomed pigs' ear skin. The donor compartment contained 10 kDa FITC-dextran solution (0.1 mM) in phosphate buffer at pH 7.4. The receiver solution was a phosphate buffer (pH 7.4) thermo-regulated at 37°C. The concentration of FITC-dextran in the receiver compartment after laser treatment was measured with a spectrofluorometer.

For skin pretreatment we used a fractional Er:YAG laser (2940 nm) with SSP (length: 50  $\mu$ s), SP (length: 100  $\mu$ s) and MSP (length: 300  $\mu$ s) pulses. Results showed that transdermal transport was enhanced compared to the control (untreated skin). For the same pulse energy used, short SSP pulses were the most efficient in enhancing transdermal transport of FITC-dextran (Figure 1).

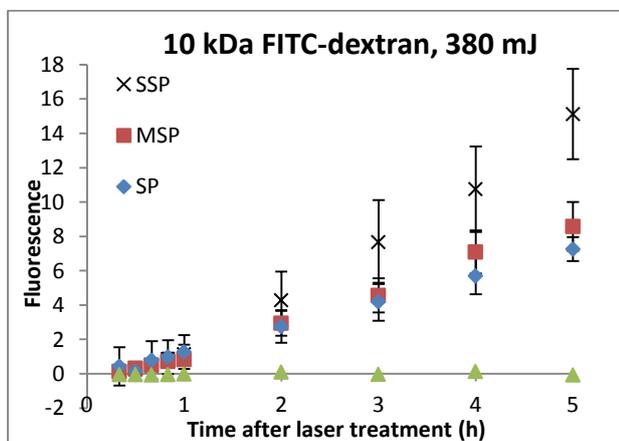


Fig. 1: Transdermal transport of FITC-dextran: the effect of different types of pulses with the same energy.

Further, as pulse energy has a great influence on dextran flux through the skin, we tested laser pulses of different energies. We compared the energy impact of SSP pulses. As expected, the transport of FITC-dextran through the skin increases with increasing pulse energy (Figure 2).

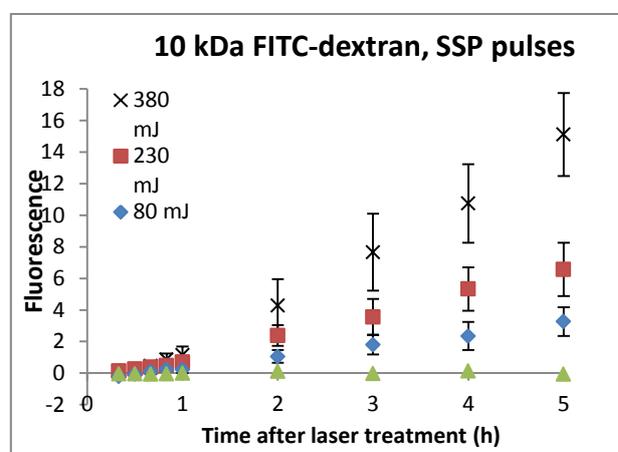


Fig. 2: Transdermal transport of FITC-dextran: the influence of the laser energy of SSP pulses.

The results demonstrate that fractional laser microablation is an efficient physical method for enhancing skin permeability. The microscopic holes produced as a result of this manipulation allow the delivery of large molecules through the skin. The size of these pathways range from 200-500  $\mu$ m wide and 20-150  $\mu$ m deep, as can be seen on histological sections of the laser-treated skin samples (data not shown). The size of the pathways limits the size of the molecules that can be delivered, as can be seen in Figure 3; there is no significant difference between a delivery of 4 kDa and 10 kDa, while the delivery of 20 kDa dextran is significantly lower.

Since transdermal drug delivery has a large potential for delivering drugs that are not suitable for administration through other routes, it is necessary to temporarily reduce skin barrier properties to ensure therapeutically significant delivery. As mentioned above, this can be successfully achieved by using fractional laser.

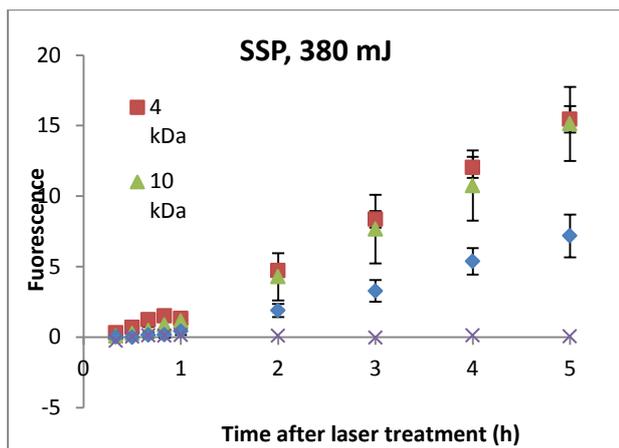


Fig. 3: Transdermal transport of FITC-dextran: comparison of different molecular weights of the delivered molecule.

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