Real time control and visualisation of 2D dosimetry in laser lipolysis.
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Laser adipocytolysis uses the thermal properties of a laser beam to induce a reduction of subcutaneous fatty tissues. The procedure is performed by using a thin cannula inserted within the tissue. Because of the low amount of direct interaction between the laser beam and the tissue, the area to be treated has to be scanned in successive back-and-forth motions within the tissue so as to bring about a homogeneous fat lysis.

The treatment requires skill from the practitioner in order for the energy to be homogeneously applied while performing back-and-forth motions. The very nature of this back-and-forth motion implies longer exposures at the ends of the strokes (when the speed is nil), leading to a higher deposition of energy. Furthermore, no solution exists today for assisting the practitioner in distributing and controlling the energy distribution upon the treated area.

This study aims to develop a new tool to assist the practitioner in achieving homogenous, repeatable and safe treatments.

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**Background and Objectives**

Treatment efficacy is typically based on the following indicators including: 1/ total dose delivered to tissue, 2/ surface temperature, or still 3/ resistance exerted by tissue while the canulla is moving. Whilst successful adipocytolysis can be correlated with each of these parameters, the latter should not be considered as a possible treatment target. A treatment based on the total delivered dose would require an accurate knowledge of the treated tissue volume. The notion of surface temperature does not take into account tissue thickness or potential heat leakages from deep perfusion. Finally, the fibrous nature of tissues may considerably vary from a person to the other.

The LipoControl system has been designed to display real time mapping of energy delivered to the fatty layer. This system is based on the 3D-acquisition of the canulla tip position. It helps the practitioner homogenize his treatment as well as control both overdosed and underdosed areas. It also allows for modulation of the laser power depending on the speed of the canulla, thereby ensuring a homogeneous and safe treatment.

The aim of this study is to assess the contribution of real time control and visualization of 2D dosimetry compared to conventional laser lipolysis. First, we created a simulation to evaluate the interest of power regulation. Then, a laser lipolysis procedure was performed with and without real time control and regulation of laser power. Same cumulative energy levels were used in both cases.

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**-From a technical point of view:**
- Standardized procedure
- Optimized procedure and settings
- Optimized outcomes
- Shorter learning curve
- Safer procedure

**-From the perspective of the physician:**
- Provide a precise history of treatment carried out
- Improved physician comfort
- Reduced procedure time
- Easier follow-up

**-From the perspective of the patient:**
- Minimized side-effects
- Improved patient comfort
- Higher satisfaction rate
LASER ADIPOCYTOLYSIS: 2D-DOSIMETRY CONTRIBUTION IN REAL TIME CONTROL OF TREATED TISSUE VOLUME

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Study Design and Methods

Simulation:
Modeling of temperature rise and accumulated energy deposited in tissue during a back and forth movement at 1Hz, for 10 seconds, with 12W power over a range of 5cm was performed with and without power regulation.

Laser lipoysis:
A laser lipoysis was performed in a phantom, with and without regulation at the following specifications:

LipoBird: 3D Sensor
A 3D positioning system was plugged at the rear of the handpiece.

Probe calibration and ROI definition
By using the handpiece, physician defines the perimeter of the area to be treated. The ROI is showed on the screen. The position of the canulla is permanently located in relation to this ROI.

Laser power regulation:
Laser power was regulated, depending on probe speed obtained from the 3D positioning system.

Dosimetry monitoring:
On-screen energy mapping shows real time distribution of energy.

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Results and Conclusion

Simulation results:

Laser lipolysis: Without LipoControl regulation

Energy cartography realised without monitoring nor power regulation, 10W laser and 1000J.

With LipoControl regulation

Energy cartography realised with monitoring and power regulation, 10W laser and 1000J.

A significant improvement of the distribution homogeneity of the energy doses with a significant drop of overdosed spots can be noticed. In conclusion, 2D-dosimetry for real time control of the treated tissue volume is an innovative approach that ensures reproducible treatments by taking into account the speed of movement of the canulla and consequently the dose being delivered at any point.