



UNIVERSITY OF SARAGOZZA, SPAIN

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PRELIMINARY RESEARCH OF CAVITATION DEVICE MEDICELL

During years, science has researched how to selectively destroy fat cells without surgical operations. We should not forget that liposuction, although seemingly appears as a minimally invasive surgery, actually could be defined as a very destructive surgery carried out by a very small hole.

All researches have been based on the use of ultrasounds, looking for selective generation of a direct effect denominated cavitation, for fat tissue.

But until now there was not a proper frequency to get the cavitation effect to the correct depth and only focused to fat tissue.

All ultrasounds devices emit a fixed frequency, since this frequency depends exclusively on the piezoelectric material used for the production of the transducer. There are two typical forms of propagation of ultrasonic waves: traverse or longitudinal. In longitudinal propagation, the wave spreads in the same direction as compression and depression areas. In traverse propagation, the waves spread in ortogonal direction (in right angles) towards compression and depression areas. The traditional ultrasounds emit waves spreading in both senses.

In this sense, MEDICELL is not a conventional ultrasounds device, since it is able to emit ultrasounds in a band of frequency and not in a single frequency. Waves are also emitted in longitudinal direction constantly generating compression and depression through one direction, although compression, due to the emission frequencies, prevails on depression. This is basic for a localized cavitation on fat tissue. We have to remember that density of fat is $0.92 \cdot 10^3 \text{ Kg/m}^3$, which leads the waves of device to be transmitted with speed of 1480 m/s, given the formula of the speed $v = (K/\zeta) \cdot 1\sqrt{2}$. Due to the less acoustic impedance of fat (see chart), the absorption of energy given by the Medicell will be absorbed in a bigger way by this tissue.

Material	Za (10^6 Rayls)
Air	0.0004
Fat	1.38
Muscle	1.7
Liver	1.65
Bone	7.8
Water	1.48

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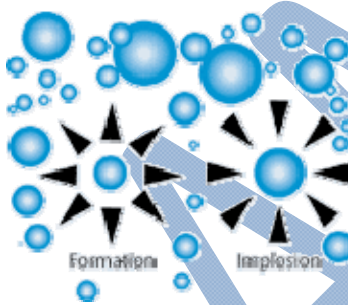
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The fact that sonic energy emitted by MEDICELL is mainly absorbed by the fat tissue is highly important, since the absorbed energy is the capacity of retention of acoustic energy from the exposed means to the radiation, which becomes its biggest part in heat due to the close contact among particles. This effect will be responsible for two direct physiologic effects:

- 1) Hyperemia in capillary area and precapillary for arterial vasodilatation that can be attributed, partly, to the excitement of the vascular nervous plexuses.
- 2) accentuation of the metabolism intercellular caused by increase of the cellular membrane permeability

But what is cavitation? It is a physical phenomenon, caused by the crash of sonic waves inside liquid element. It is a phenomenon due to the disintegration of liquid particles, giving the appearance of an evaporation for pressure action of ultrasonic beam. This fact produces such energy concentrations that can lead to disintegrations of fixed complex cellular or macromolecules. This fact is showed in following pictures, in which the liquefaction of triglycerides contained in adipocitis, for emulsification or physical rupture of its molecules.

The cavitation is a phenomenon that appears when oscillations of pressure are introduced in a liquid. If the minimum pressure reaches the pressure of vapour of liquid the vacuum bubbles grow and collapse when pressure increases again. In some conditions vacuum bubbles implode and the compression effects on bubbles internal gases can cause high temperatures and internal pressures of 104 K and 103 atm respectively. This phenomenon is showed in two following figures:



"pictures showing the generation of bubbles and their following implosion"

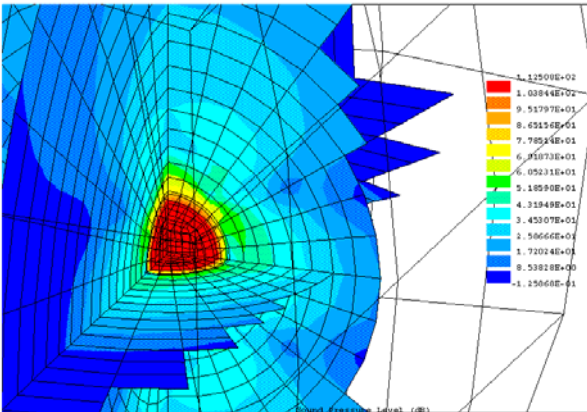
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"picture showing the high temperatures that reaches the nucleus of bubble before implosion"

Cavitation can cause two more effects:

- 1) mechanical movement inside the cellular complexes to internal part of cells. This movement depends on the density of power and of frequency, causing an internal viscous friction
- 2) chemical effect for division of long molecules in chains, ionization and, consequently, formation of free radicals and niters.
- 3) fat cells get sequentially destroyed. Due to the fact that they firstly are hit by cavitation effects, the adipocitis, which have a wall with more tension, are "inflamed", so treatment can be highly selective and effective.

In the following images we will see the microscopic confirmation of cavitation effect generated by the cavitation device MEDICELL

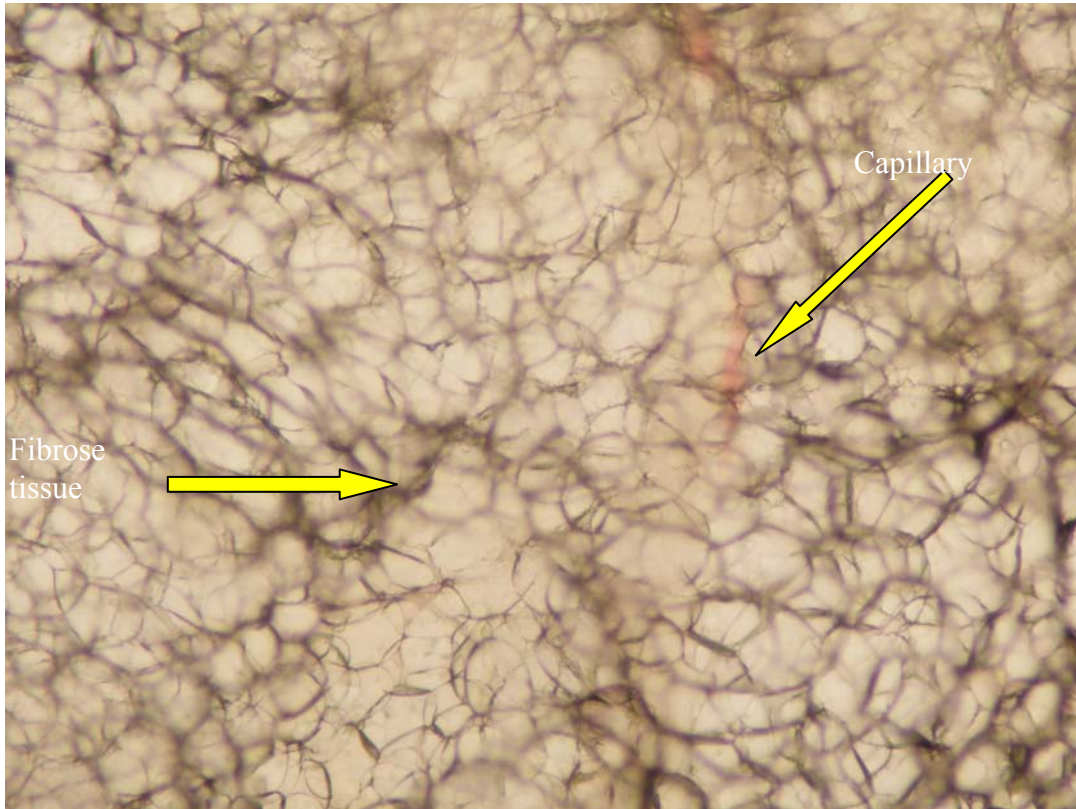
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"demonstration of fat human tissue of the abdominal area, before beginning the cavitation process"

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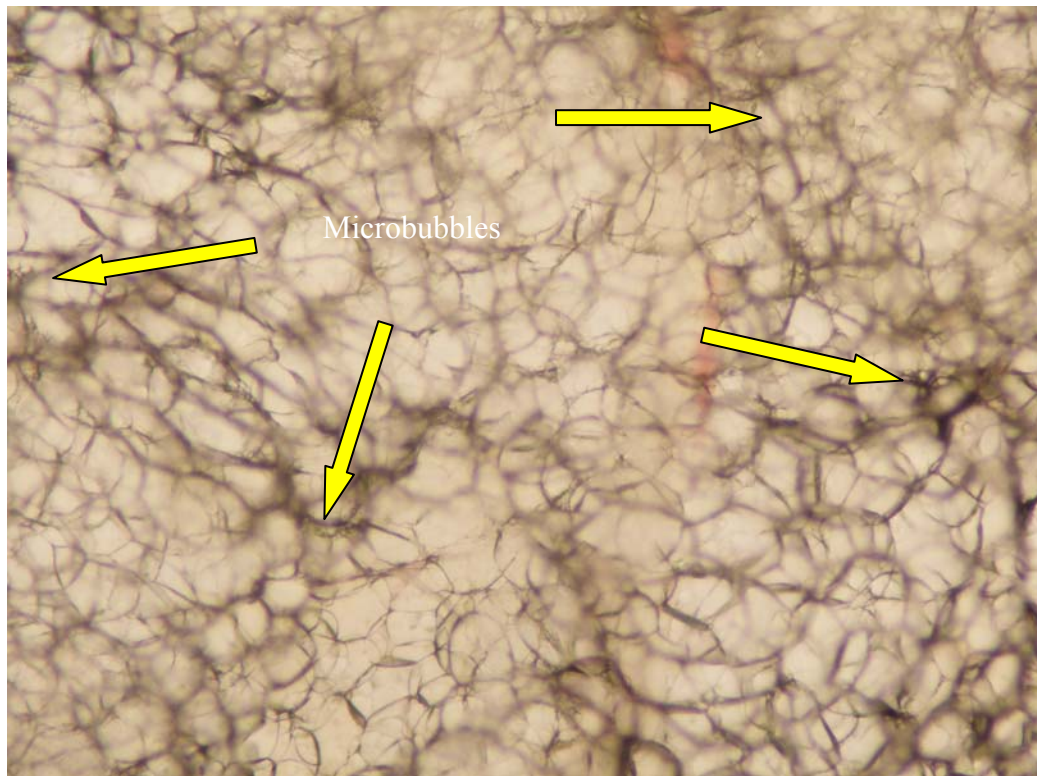
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"Image showing the beginning of bubble generation, fair to the side of the fibrous partitions and of the biggest adipocitas; the sample is taken after 20 seconds of cavitation treatment"

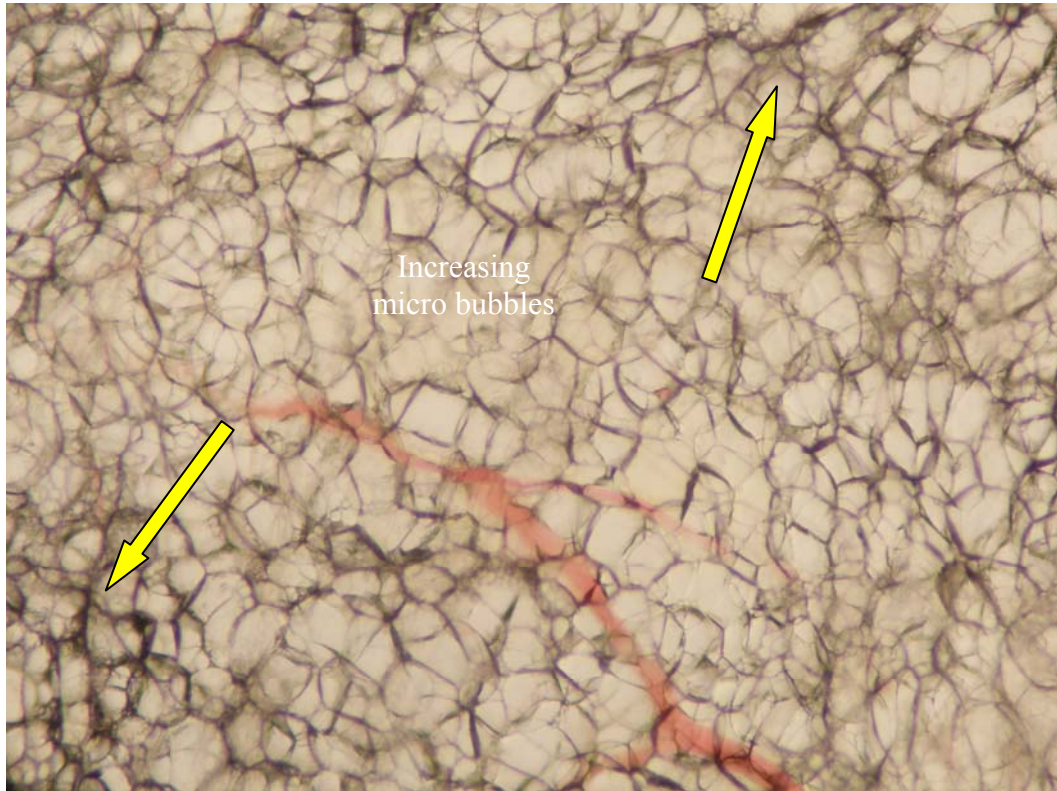
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"Here we see the increase of the number and size of the bubbles; this fact takes place 40sec approximately after the beginning of the treatment"

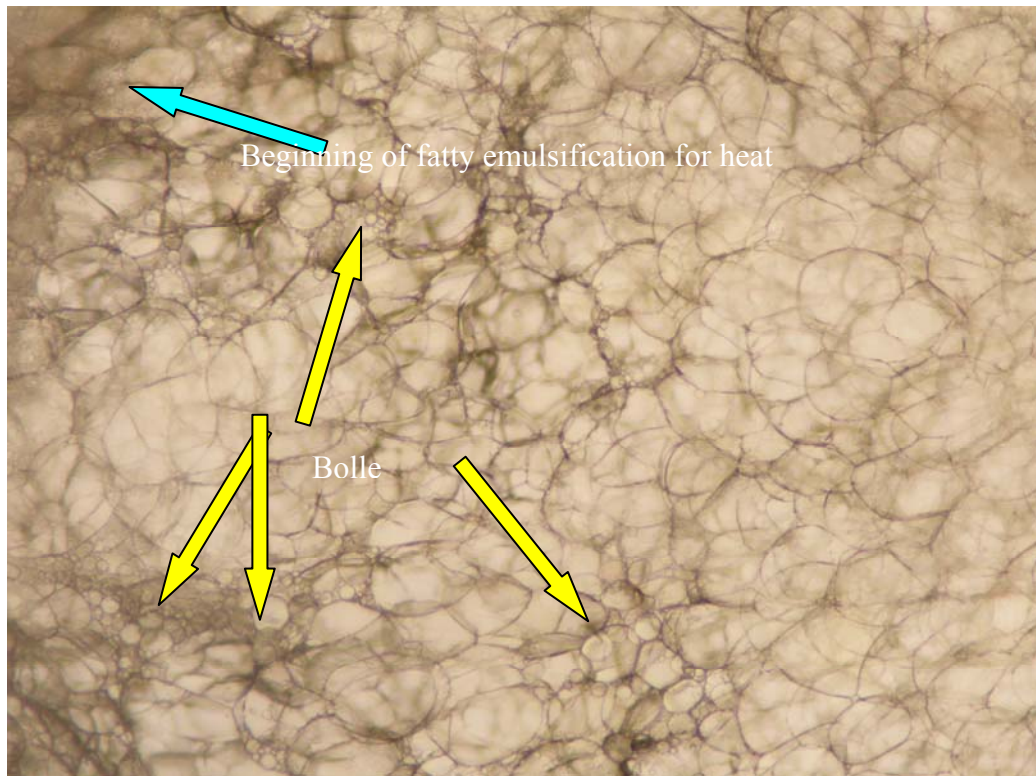
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"After a minute of treatment. an exponential increase of number of bubbles. we begin to see in the left superior area of the image the formation of a serous liquid, result of the emulsification of the fat"

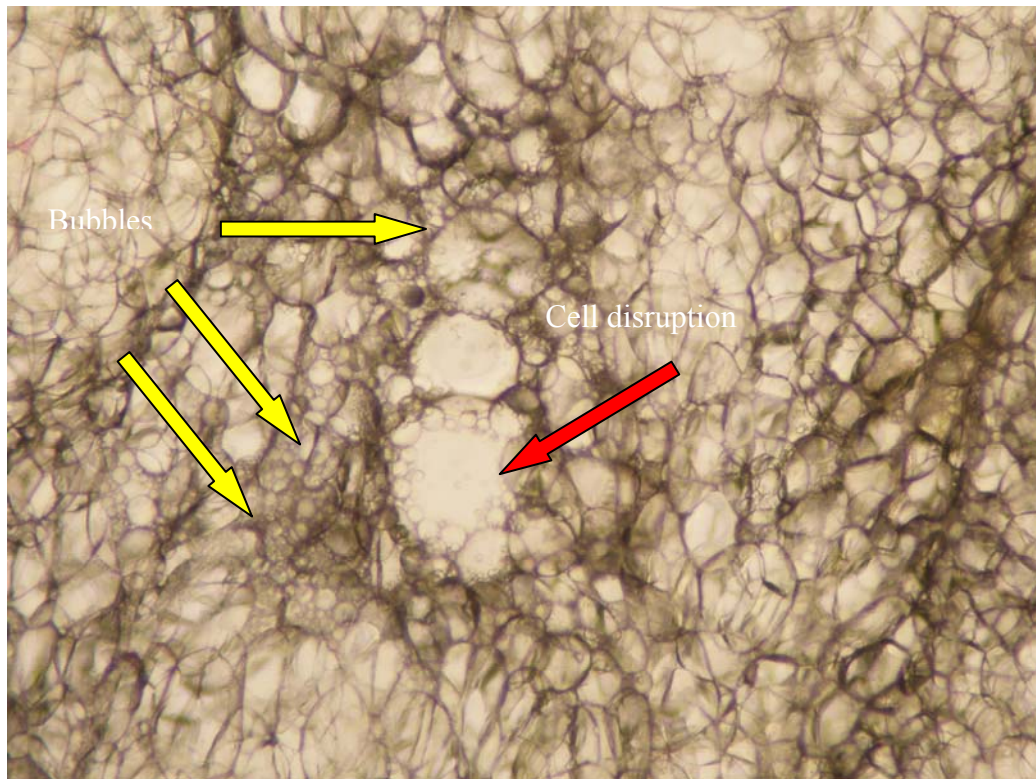
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"After two minutes of treatment, due to confluence of a great number of implosions, the destruction of fatty cells begins (see red arrow) "

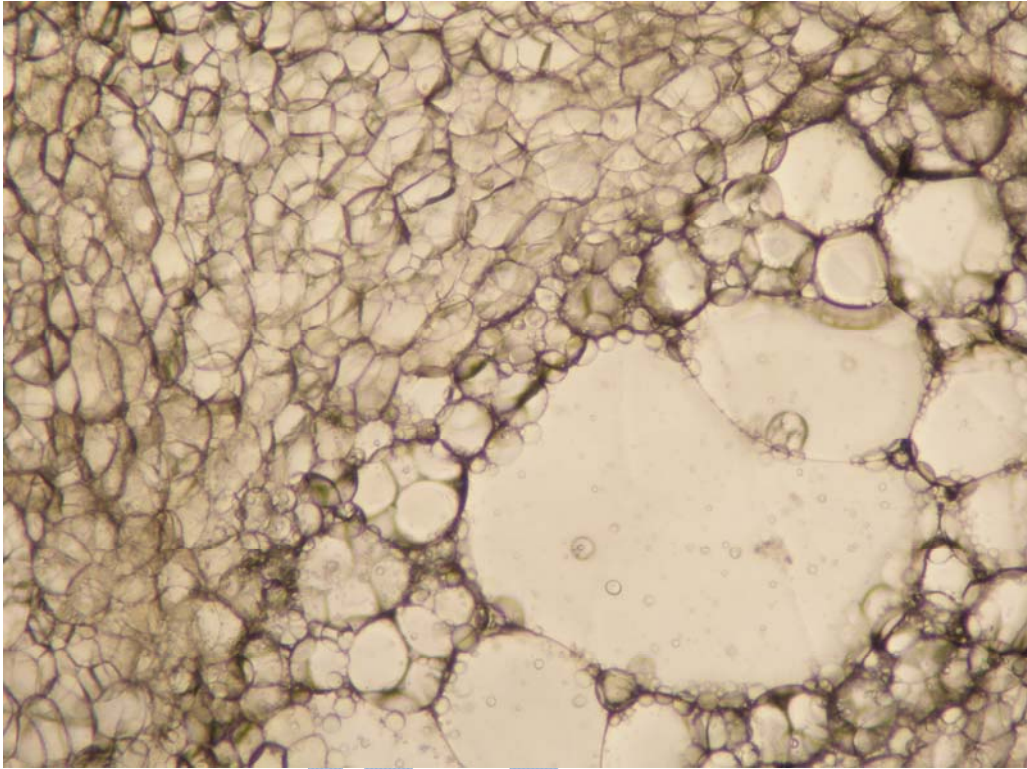
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"After 3 minutes of treatment, we can observe as the areas of destruction of fatty tissue increases"

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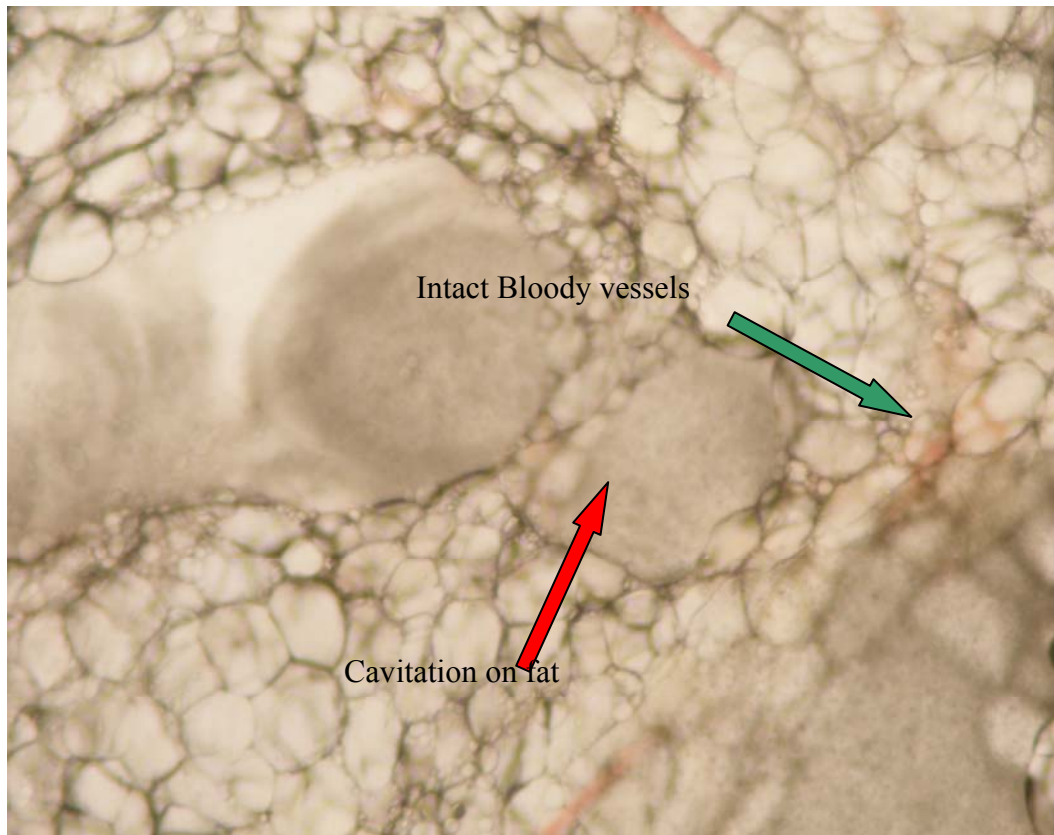
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"In this image we can observe the selectivity of the treatment: areas of adipocitary destruction and capillaries are completely intact"

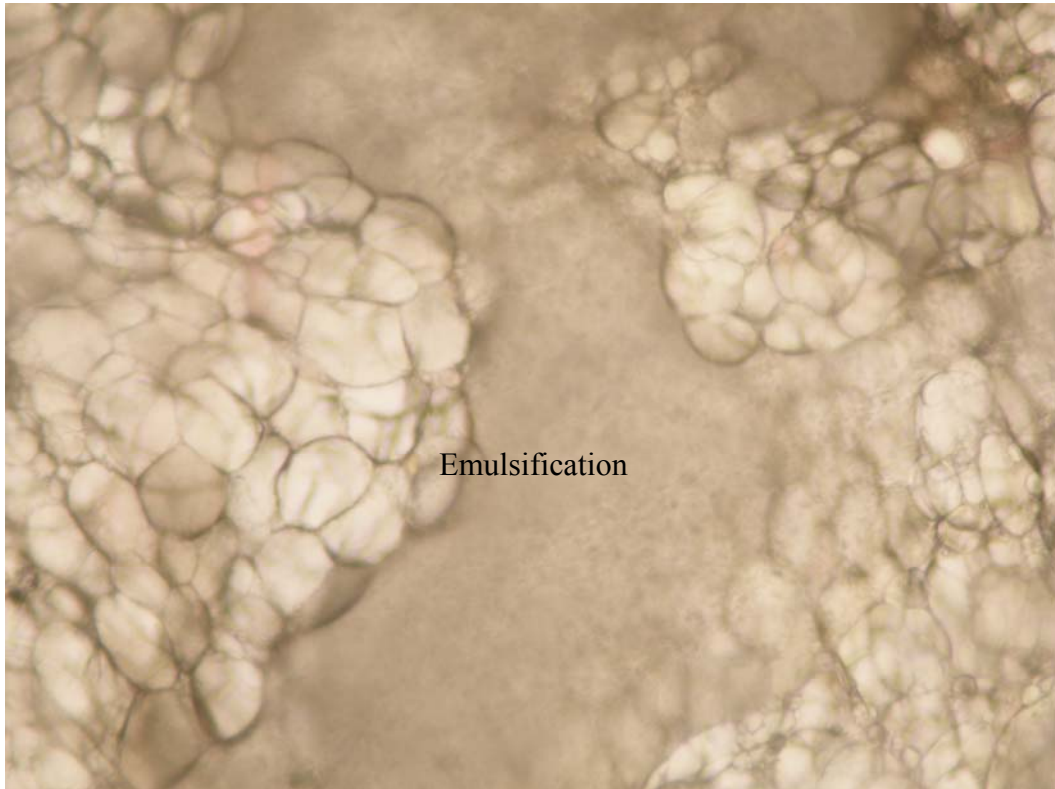
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"After four minutes of treatment, the emulsification and rupture of the contained triglycerides in the exposed adipocitas, are maximum"

In the different samples taken at beginning and during the treatment, we could appreciate the effectiveness of the cavitation device MEDICELL, as well as its impossibility to create possible damages in other closed tissues.

The emulsified fat, will be evacuated by lymphatic and veined roads, since, the cavitation causes physical changes in the fat and makes it soluble in water, for what this fats will be finally eliminated by urine.

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