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WHITE PAPER

Onda

HOW THE NEW ONDA SYSTEM WORKS: THE COOLWAVES™ EFFECT

June 2018

How the New Onda System Works: The Coolwaves™ Effect

Selectvity

The ONDA system handpieces generate waves at 2.45 GHz which turns out to be a very selective frequency for fat melting. In fact this frequency, that belongs to the microwave domain, is preferentially absorbed by fat molecules rather than by water molecules. This means that it is minimally absorbed by the dermo-epidermal layers while it leads to the subdermal fat tissue.

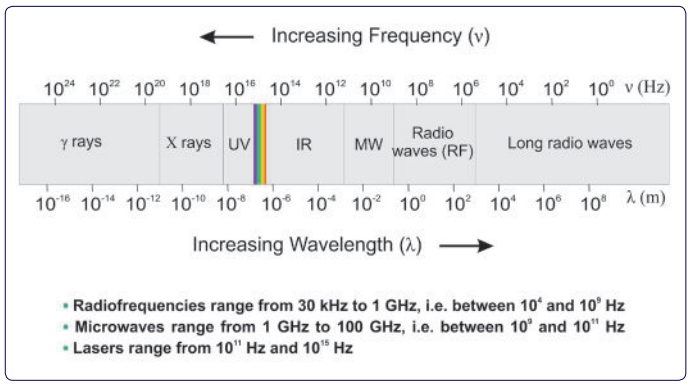

Figure 1. The Electromagnetic Spectrum.

The reason of this lays into the different behavior of tissues once withstanding to the 2.45GHz energy application. The different value of conductivity of the various layers specifically at this frequency makes the energy almost totally transferred to the subdermal fat layers.

For Coolwaves™ the conductivity of the outermost layers of skin is at least 3.5 times higher than that of the commonly-used RF irradiation systems in aesthetic medicine (figure 2). That means that most of the RF energy gets stuck in the epidermis and dermis, heating them up to such an extent that there is a risk of tissue damage. Moreover, as the RF energy remains close to the surface, it fails to reach the hypodermis where the fat cells are located, and whose membranes must be broken in order for the treatment to be effective.

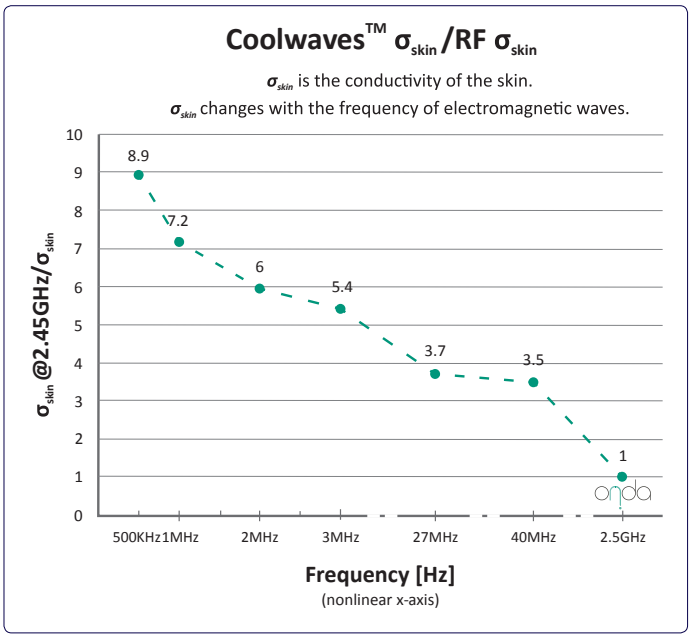

Figure 2. Coolwaves™ σ_{skin} / RF σ_{skin}.

Action on the Subdermal Fat Cells: Adipocitolisys

A "normal" fat cell has the appearance shown in the figure 3.

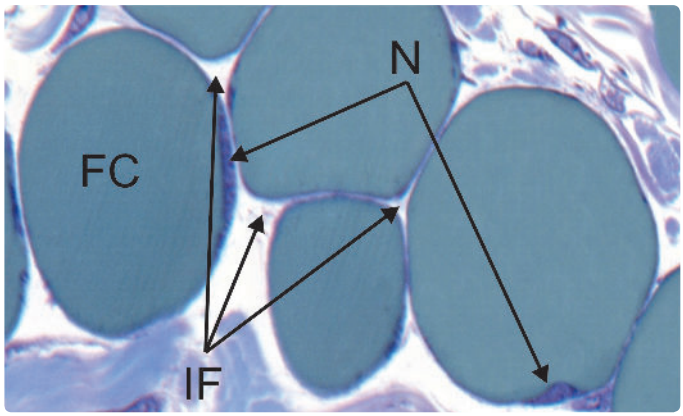

Figure 3. Main elements of a fat cell. FC: fat content; N: nucleous; IF: interstitial fluid.

If we try to make an adipocyte magnification is it possible to observe more details as shown in the figure 4.

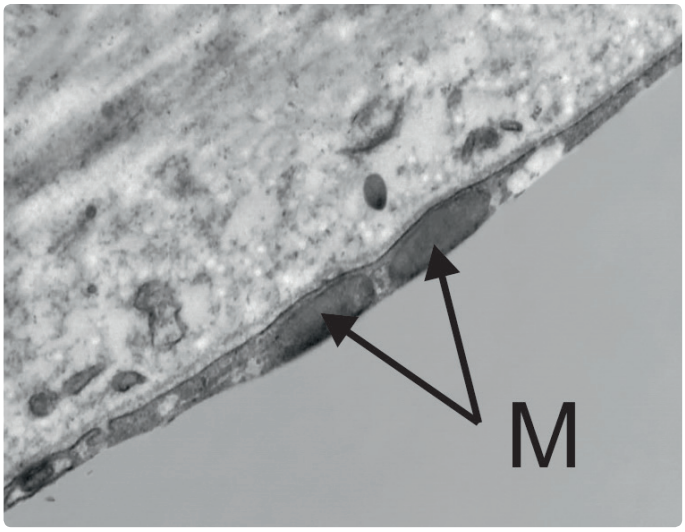

Figure 4. Adipocyte detail where "normal" mitochondria are evident (M). Mitochondria are in charge of the ATP (energy) synthesis, for this reason they are so important.

Once driven onto the subdermal layer, the 2.45 GHz energy produces a metabolic stress into fat cells. This stress is about inducing an imbalance inside the adipocyte.

How the stress is induced: The selective heating gets the adipocyte to get hot. This thermal increase leads the fat content to change its chemical structure (Glycerol + Fatty Acids) and this makes the cell to increase its metabolism to "sweat" this composition outside. This "sweat" of adipocytes that loose small fat drops is called blebbing effect (figure 5). Blebbing occurs without breaking their membrane. In this moment the fat cells empty and reduce their size only.

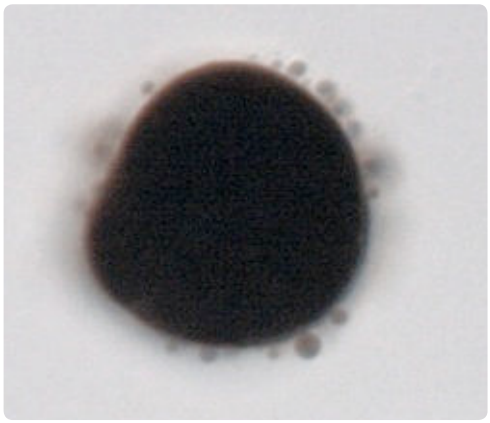

Figure 5. Stressed adipocyte 6 hours after Onda treatment, with evident "blebbing" effect all around its perimeter.

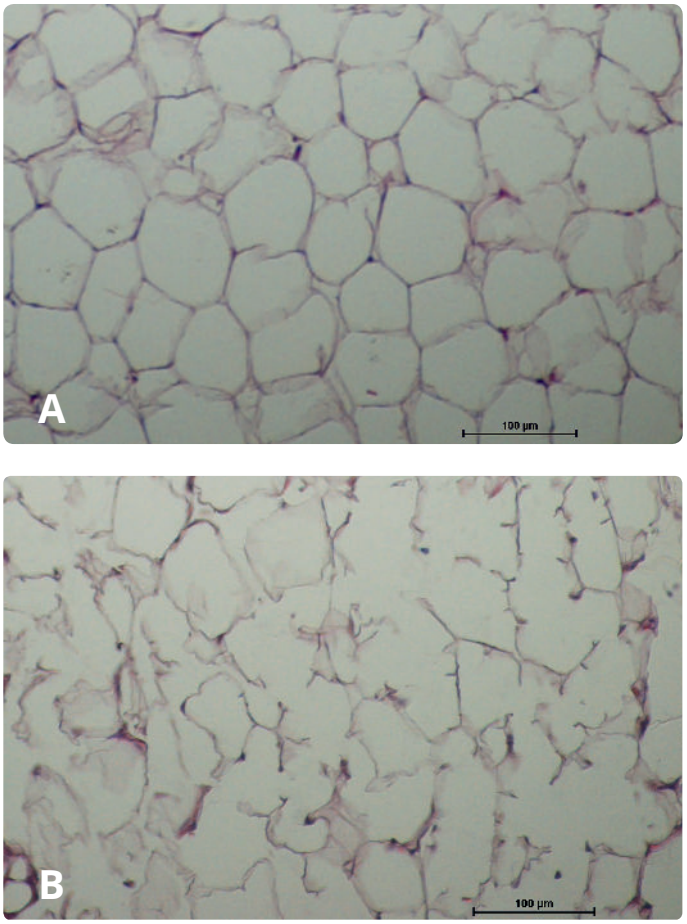

Figure 6. Histological images of tissue with human abdominal fat (magnification x20). (A): Control. (B): Sample from the same patient immediately after treatment with Onda Coolwaves™. Image (B) clearly shows adipocytes with broken membrane and initial hyperaemia with dilatation of the blood vessels. *Courtesy of Prof. R. Perrotta, M.D. and M.S. Tarico, M.D., Catania - Italy.*

As soon as the cellular stress increases, the blebbing can increase too much or too quickly and, at the end, the adipocyte simply arrives to break the membrane (as shown in the figure 6).

Let's explain this passage either: more blebbing effect requests the cell to accelerate its metabolism to manage the blebbing phenomena. The inner of mitochondria membrane is folded into a series of internal ridges called cristae. Normally in the mitochondrial cristae two chemical reactions occur that lead to the production of ATP (we speak of oxidative phosphorylation). Once these two chemical reactions are in balance, the ATP produced is used by the cell for living and growing up. On the contrary,

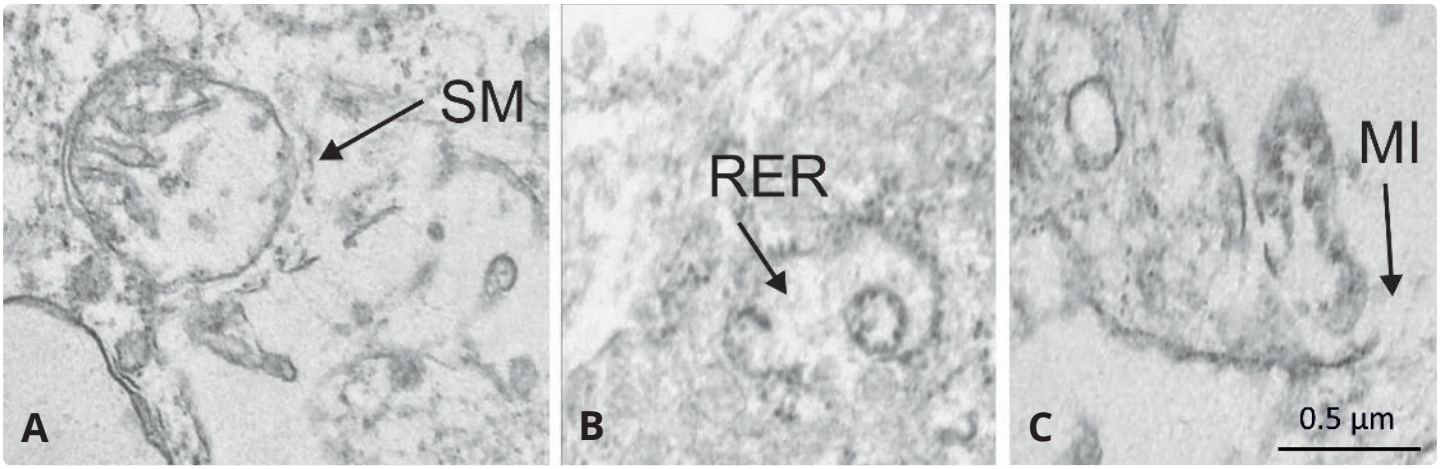

Figure 7. Signs of cellular stress 6 hours after one treatment with Onda - Coolwaves™ . In the image A it is possible to observe a swollen mitochondria (SM). In the Image C the arrow shows the dilated Rough Endoplasmic Reticulum (RER). In the Image C it is visible a membrane interruption (MI).

the metabolic cellular stress, due to the blebbing, induces an imbalance of the two chemical reactions (oxidation predominates over phosphorylation) causing the production of ROS (Reactive Oxygen Species) and free radicals, instead of ATP, into the membrane. Once there, both ROS and free radicals make the membrane to break up so the cell gets into the adipocytolysis state.

The more blebbing we get the higher metabolic reaction is requested.

The typical signs of this are three[1]: swollen Mitochondria also due to the hyperproduction of ROS and free radicals, the dilated Rough Endoplasmic Reticulum (RER) and finally the membrane breakage. All of these are evident observing with the electronic microscopy a specimen of tissue after treatment with Onda – Coolwaves™ as shown in the figure 7.

Remark: Not all cells may break the membrane though (cells far from the heating core point for instance). So, depending on the level of cellular

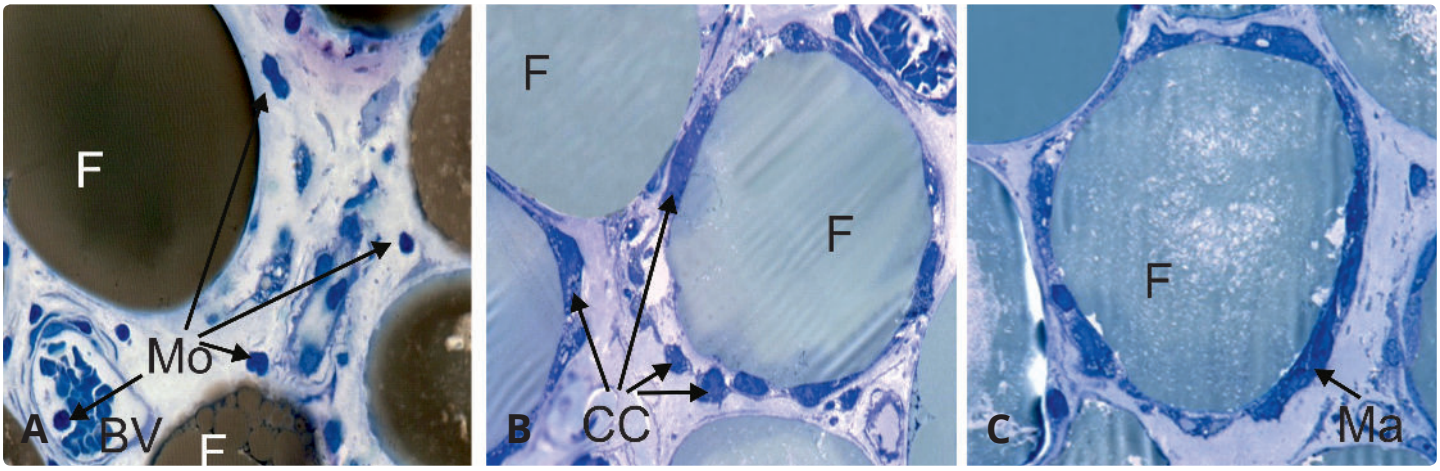

Figure 8. Signs of adipocytolisis 1 month after 1 treatment with Onda - Coolwaves™. Optical microscopy images. In the picture A it is possible to observe a blood vessel (BV) with monocytes (Mo) inside, while many other monocytes are already out of the vessel because recalled by the blebbing. In the bottom of the same image it is possible to observe a fat cell (F) with evident blebbing activity. In the image B monocytes gathering together around the fat cell and get forming "CROWN CELLS" (CC) for their crown-like shape around the compromised adipocyte cell. Finally in the image C, monocytes once connected together (crown-like shape) form a macrophage (Ma) cell that start eating the fat cell.

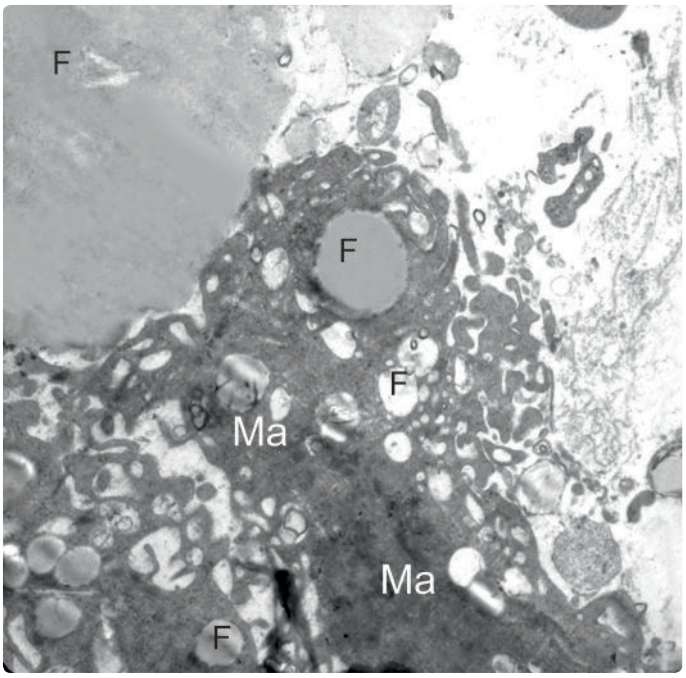

Figure 9. Signs of adipocytolisis 1 month after 1 treatment with Onda - Coolwaves™. Electronic microscopy Image. It is possible to observe a big quantity of fat on the top-left corner that is part of the remaining fat cell being eaten (F). The Macrophage (Ma) has already incorporated many fat drops for eating them.

stress induced by Coolwaves™, some cells break their membrane while other cells, located in other parts of the body, are interested only by the "sweating" effect.

Moreover, consider that, even if the fat cell doesn't have an immediate membrane break, it can suffer for an unrepairable damage and die in the following weeks.

In both cases there is a physiological activation of macrophages that "eat" the fat leaked from the adipocytes and eliminate it through the lymphatic system (we call it macrophage lipolysis).

What Happens Now?

The blebbing effect is responsible of a first recall on site of Monocytes that progressively gathering together around the fat cell and connect to become Macrophages. In case of stronger blebbing and consequent breakage of the membrane, the cell gets into adipocitolisys (death) and it is eaten progressively by the macrophages (figure 8 and figure 9).

Figure 10. Optical microscopy images 1 month after 1 treatment with Onda - Coolwaves™. In the red circle is evident a "Y-shape" lymphatic vessel branched among three adipocytes. Inside the vessels it is possible to identify macrophages with many fat drops inside.

Where Does the Fat Go Once Eaten?

Once eaten by macrophages the "former adypocite" cell is physiologically eliminated by the lymphatic system (figure 10).

What about the Skin Then?

For the particular characteristics of the Coolwaves™ as well as the specific smart handpiece of Onda system (patent pending), there is no damage on the epidermis and derma (as shown in the figure 11).

As per the histological image above, there are no noticeable differences between the control sample and the post Coolwaves™ delivery sample. This means the derma epidermal structures are either preserved and not interested substantially from the treatment.

Remembering Smartlipo®...

In the figure 6B, immediately after one Onda treatment, it is clearly evident the adipocytes

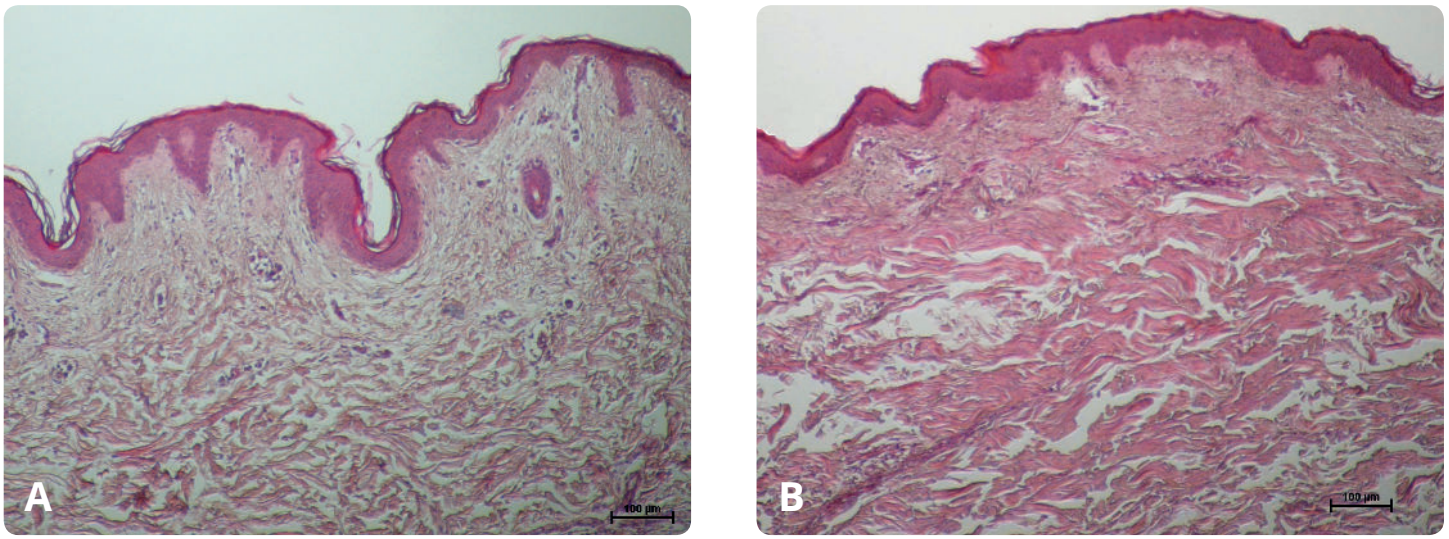

Figure 11. H&E histological images of human abdominal tissue. (A): control. (B): Sample from the same patient immediately after treatment with ONDA Coolwaves™. When we compare the two images, it is clear that the epidermis in the treated sample has not undergone any alteration compared with the control. Moreover, in image (B), the collagen in the dermis looks more eosinophilous (pink): heat causes shrinking or tightening of collagen, resulting in greater eosinophilia, due to the higher collagen concentration, and is always accompanied by the presence of lighter-coloured spaces clearly visible in H&E, freed up by the aggregating collagen. *Courtesy of Prof. R. Perrotta, M.D. and M.S. Tarico, M.D., Catania - Italy*

with a broken membrane and initial hyperaemia with dilatation of the blood vessels. Similarly to SmartLipo®, Onda is able to break membranes but trough a totally NOT invasive technique. SmartLipo® was able to create adipocytes membranes ruptures in some parts of fat layer and stressing fat cells (without breaking their membrane) in some other parts just inducing unrepairable damages.

As both the efficacy and safety of SmartLipo® is worldwide recognized and proven by thousands of happy treated patients for more than 10 years, Onda is on the same track now producing a similar effect through a non-invasive technique. This is the revolution of Onda System!

Bibliography

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DEKA
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DEKA M.E.L.A. s.r.l.
Via Baldanzese, 17
50041 Calenzano (FI) - Italy
Ph. +39 055 88.74.942
Fax +39 055 88.32.884

www.dekalaser.com