

THE BIG FREEZE

Mike Murphy asks if cryolipolysis is the future of body contouring?



Mike Murphy is a physicist/bioengineer who has been involved in

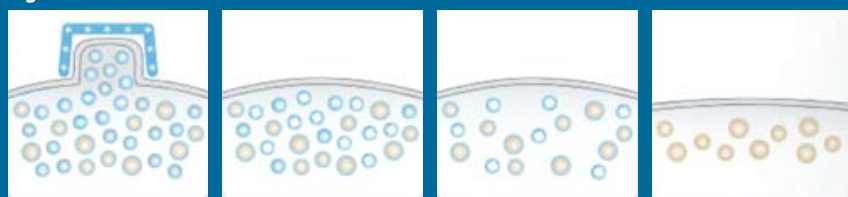
medical laser research since 1986 and in the commercial sector since 1989. His original research group developed the scar-free removal of tattoos by Q-switched ruby laser in Canniesburn Hospital, Glasgow. He now runs training courses on IPL systems and aesthetic lasers and their applications. www.dermalase.co.uk

Cryolipolysis is a relatively new, non-invasive procedure with the first published^{1,2} research data appearing in 2008 in America. Since those original studies the technology and results have improved rapidly resulting in a number of commercial systems now available. The first reports into this procedure revealed a “grossly obvious loss of several mm of subcutaneous fat” with “no clinical or histological evidence of injury to skin, and no scarring.” Cryolipolysis is a relatively straightforward process based on the principle that human cells are susceptible to cold temperatures. In particular, it appears that human adipose tissue is preferentially damaged by exposure to very low temperatures, compared with skin cells. A subsequent inflammatory response, known as ‘cold panniculitis’, along with a marked increase in macrophages appears to be the main mechanism behind the removal of non-viable adipocytes resulting in a significant improvement in the body contour (fig. 1). The first devices used for this process simply consisted of a flat, circular copper plate which was gently pressed against the skin. While this method produced some results they were not consistent, nor

particularly good. An improved device allowed a section of skin to be sucked into a ‘cup’, using vacuum pressure, which allowed for two cold plates to be applied on either side of the skin/fat section (obviously, only those parts of the body where the skin laxity allows such a procedure such as the stomach, thighs and back). In addition, the pressure was sufficient to minimise cutaneous blood flow in that section of skin thereby reducing the heating effect of the blood during the procedure.

Typical treatment temperature settings are typically in the range -4 to -7°C applied for up to 60 min in order to achieve thermal equilibrium in the treated tissue volume. After an initial mild discomfort felt by the patient the process is well tolerated by virtually everyone – indeed, patients have been known to read a magazine or make phone calls during the treatment! Over the period of the treatment session the skin and fat layers lose heat to the cold plates – hence their temperatures drop. Studies indicate that, after a suitable period of time, the tissue temperature between the plates can become nearly as cold as the plate temperature. However, this does not result in any significant damage to the dermis or epidermis in humans³. Observations suggest that the freezing point of cytoplasmic lipids in adipocytes is higher than that of water. Hence the freezing process will result in ‘lipid ice’ before the formation of water ice. Histological studies¹ reveal the presence of lipid crystals within the adipocytes after the above procedure. To achieve this there must be sufficient heat extracted from the lipid such that the latent heat of freezing is induced resulting in crystallisation. This, therefore, requires a suitable low temperature being applied for a suitable time (the opposite of thermally raising cell temperatures to achieve protein denaturation,

Figure 1:



Precisely controlled cooling is applied through the skin targeting the fat layer.

When the fat cells are exposed to precise cold, they begin to crystallize, deteriorate and die.

For several months after treatment the fat cells continue to deteriorate, and are naturally eliminated from the body.

The removal of fat cells from the targeted area results in a natural looking reduction of the fat layer.

as in the removal of hair and blood vessels). Hence, a level of selectivity is achieved since there is a significant difference in the freezing temperatures of lipids and water! Consequently this process is known as 'selective cryolipolysis' (similar to 'selective photothermolysis' for the opposite process). Ultrasonic investigations reveal a direct correlation between the level of the cooling intensity and the measured reduction in fat layer thickness. However, there may also be an additional effect due to reperfusion. It is known that fatty tissue is susceptible to injury by reperfusion^{4,5}, which will occur at the end of this procedure when the cutaneous blood flow is re-established. It may be that the combination of lipid freezing and reperfusion damage is required to successfully destroy the affected adipocytes. This is still under investigation.

Further cell damage appears to occur as a result of the inflammatory response post-treatment. This process may also damage those cells which were not adversely affected in the freezing process thereby increasing the total volume of affected adipocytes. However, it was noted that the epidermis and the dermis did not suffer from any inflammation post-treatment and that the blood vessels remained undamaged.

A study² into the potential damaging effects of cryolipolysis on nerve tissue found minimal, transient problems in most patients with only mild numbness and erythema lasting for up to seven days post-treatment. However, these mainly affected the pain receptors for up to two weeks with no long term after-effects. The researchers also observed minimal effects in other tests including temperature sensitivity, light touch stimulation, two-point discrimination and a pin-prick stimulation. All of these effects were resolved within two months following the treatment. However, they also measured an average of 20% fat reduction in the treated areas at two months post-treatment and 25.5% reduction at six months, thereby verifying the original study results

Most healthy people may present for this treatment but it is not recommended for obese patients - it is not a weight loss procedure. Rather, it is useful for fat contouring of those hard-to-lose parts of the body such as 'love-handles', thighs, the back and buttocks. A patient may undergo a number of treatments in a single session on different body areas. Results can be expected to be visible within four to six weeks in most cases. Multiple treatments can be applied

to patients after a suitable period, typically three to six months.

As with most treatments there are some contraindications including pregnancy, circulation disorders, diabetes, skin infections, dermatitis, cold urticaria, systemic treatment with isotretinoin (e.g. Accutane, Roaccutane), cancer chemotherapy, radiation therapy, steroid treatment, recent use of NSAID (Non Steroid Anti Inflammatory Drugs) medication (since both these drugs will increase the risk of getting severe bruises), Raynaud's disease or other peripheral vascular diseases. (Note: this list is not exhaustive). Typical fees have been quotes at between £500 and up to £1500 per session depending on the area(s) treated. Patients may require up to three hours in a single session if more than one treatment site is tackled. Follow-up assessment sessions are required at three and six months post-treatment. In some cases further treatment sessions on the same area can be carried out three months after the previous treatment.

A comparison between non-invasive technologies

Cryolipolysis – Although this is a relatively new procedure there are a small number of backed by peer-reviewed clinical studies available^{1,2,3}. These reports clearly indicate a demonstrable loss of fat in the treated areas using both visual inspection and histological evidence.

Radio-Frequency – This process uses heat generated by low level currents to raise the temperature of tissues. However, there is no selectivity between the different cells hence all cells respond similarly to the heating. Various clinical studies report a range of results but they all recommend a dieting/exercise regime concurrent with the treatment. An advantage of RF is its ability to tighten the skin by targeting collagen.

Ultrasound – This technique has been around for a few years and utilises high-intensity, ultrasonic sound waves in an attempt to 'alter' the adipocyte membrane resulting in a release of the triglycerides contained within. These are then used as energy or excreted by the body. As

Figure 2:



The thickness of the subcutaneous layer may be reduced by an average of 20% after 2–3 months, and even more after 6 months. Further reduction may be achieved with additional treatments.

a result the adipocytes shrink in size although they usually remain viable. As with cryolipolysis this technique delivers useful energy through the overlying skin into the fatty layer. However, unlike cryolipolysis or RF procedures this technique relies upon a mechanical breakdown of the adipocytes rather than a temperature-induced reaction.

Low Power Diode lasers – using a large number (typically >30) of low level diode lasers outputting around 5 mW each this procedure claims to induce fat loss via a photochemical process. However, I cannot find any valid, peer-review clinical studies which support these claims in the literature⁶.

In summary

Cryolipolysis body contouring is ideal for removing limited amounts of body fat particularly in the stomach area, flanks, thighs and back; however, this cannot be considered a weight-loss treatment; multiple treatment may be required in some cases; the skin may be a little numb immediately after the treatment and the patient may lose some nerve sensation for a few days post-treatment; erythema is likely for a few hours post-treatment. The non-invasive body contouring procedures usually require little, if any recovery periods. In most cases the patients can return to normal, daily activities immediately after the treatment. My feeling is that cryolipolysis offers the best, non-invasive methods of body contouring, based on the available clinical evidence. The side-effects are minimal and not long-lasting while the benefits are obvious. Compared with other therapies cryolipolysis appears to be the 'best' option available, with only the invasive laser lipo procedure yielding better fat-loss results. If the photographic evidence is to be believed I can see this procedure becoming very popular in the UK in the very near future.

References

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