Optimising Laser Technique in Laser Sweat Ablation (LSA) – an in-vitro Study using Porcine Skin

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Purpose and background
Axillary hyperhidrosis affects approximately 1.5% of Adults in Western populations – although the prevalence can vary widely depending on the local temperature and humidity as well as the criteria used to make the diagnosis.

Laser sweat ablation (LSA) is a new local anaesthetic treatment for axillary hyperhidrosis, based on Axillary Sub-dermal Laser Ablation (SDLA). The first was performed in the UK in March 2009, using the technique taught by Blugerman of Buenos Aires.

However, using this technique and laser settings, our early results of LSA showed a good objective reduction in sweat volumes, but a high skin breakdown rate. Our first two patients were treated at 20W and had severe skin breakdown (Fig 1): subsequent patients were then treated at 10W using different speeds of laser ablation and patterns of energy application.

Observation of results suggested that this reduction of laser power, an increased speed of laser ablation and a reduction of repetitive treatments over one area reduced the skin breakdown rates without adversely affecting success of the sweat reduction (Fig 2).

The aim of this study was to investigate the effects of the laser ablation part of the LSA procedure using a Porcine skin model.

Summary of methods
Fresh Porcine skin was obtained from an abattoir. The skin was pinned under moderate tension to a board, to emulate axillary skin. A standard Laser Sweat Ablation treatment was performed by a surgeon experienced in the procedure; blunt dissection of dermis from fat, suction curettage and then laser ablation.

Blunt dissection and suction curettage were the same for the whole sample area. However, different areas of the porcine skin were marked to be treated with a range of laser ablation techniques and settings.

The laser used was a Fotona XP2 in Quasi-continuous mode (QCM) using 20 W and 10 W. The laser fibre was held at 20 degrees to the skin and the fibre was withdrawn, firing into the deep dermis from below, at set withdrawal rates (‘slow’ or ‘fast’) and at different densities (‘dense’ or ‘spread out’).

Putting figures to these variations:
- Speed of laser treatments - Timing the surgeon, the ‘slow’ pull-back was measured to be 1.3 sec/cm and ‘fast’ pull-back, 0.9 s/cm.
- Densities – ‘Dense’ treatments meant that each pullback was performed next to the last one, aiming to get a complete treatment of the deep dermis – ‘Spread out’ meant that pullbacks were performed approximately 1 mm apart halving the density of treatment

Summary of results
Histological examination of all specimens was performed blinded, by Source Bioscience (Nottingham, UK), a laboratory that specialises in animal histology for research purposes.

The results of their analysis are summarised as compared to normal untreated pig skin (Fig 5):
- 20W ‘slow’ = severe (Grade 4) thermal damage to the dermis, affecting 50-70% of the total dermis (Fig 6)
- 10W ‘slow’ = severe necrosis to the dermis Grade 3–4 (Fig 7)
- 10W ‘fast’ = severe thermal damage of deep dermis grade 4, grade 3 to mid-dermis and dermal atrophy (Fig 8)

Concluding remarks
- 10W ‘fast’ spread = grade 4 damage deep dermis, mild damage grade 2-3 of the mid dermis and sparing of the sub-cutis (Fig 9)

Figure 1: Right axilla of first patient to have LSA – 2 weeks post procedure – Technique = 20 W, slow pull-back and dense pattern ablation

Figure 2: Left axilla of 60th patient to have LSA – 8 weeks post procedure – Technique = 10 W, fast pull-back and spaced out pattern ablation

Figure 3: Left axilla of 60th patient to have LSA for hyperhidrosis – Pre-op starch and iodine test

Figure 4: Left axilla of 60th patient to have LSA for hyperhidrosis – 8 weeks post-op starch and iodine test

Figure 5: Histology of normal porcine skin – No laser treatment

Figure 6: Histology of Porcine skin after 20W slow pull-back – Grade 4 transdermal coagulative necrosis in 50–70% of biopsy

Figure 7: Histology of Porcine skin after 10W slow pull-back – Grade 3 transdermal coagulative necrosis and Grade 4 in deep dermis

Figure 8: Histology of Porcine skin after 10W fast pull-back, dense – Thermal damage limited to Grade 5-1, increasing with depth to Foul of Grade 3-4

Figure 9: Histology of Porcine skin after 10W fast pull-back, spread-out – Sub-cutis is unaffected. Dermal shows Grade 2-3 thermal damage, with Grade 4 at deepest aspect

The results from this Porcine skin model suggests that the original technique used as taught, using 20 W, a slow pull-back and spacing out the pull-back pattern, results in the same severe damage to the deep dermis (grade 4) but reduces the damage to the mid dermis (grade 2-3) and spares the sub-cutis.

These histological changes are compatible with the clinical findings of successful reduction of hyperhidrosis but an absence of skin breakdown and reduction of post-operative skin scaring and tightening.