Creation of micro-ablative thermal regions within the deep dermis by Intense Ultrasound (IUS): a new tool for nonablative facial rejuvenation

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Purpose or Rationale for presenting at this meeting:

Intense Ultrasound is a novel approach to focus energy within tissue to induce selective (0.5 – 5 mm3) micro-ablative thermal regions (MATR) in skin or subcutaneous tissues. Both ultrasound imaging and treatment can be performed with the same handpiece. The purpose of this study was to determine the IUS source conditions that would create MATR selectively within the dermis while not damaging the epidermis.

Statement of Research Design or Methodology:

Six (6) unfixed human cadaver specimens were utilized in this experiment. IUS exposures were performed in multiple facial regions of the cadaver specimens bilaterally. Ultrasound imaging was performed in the same plane before and after IUS treatment. Ultrasound probes were used that have frequencies in the range of 4 – 8 MHz, and preset focus depths of 3 – 6 mm. Combinations of IUS source power and exposure time were varied to result in exposure energies of 0.5 – 10 J. A total of over 350 ablation zones were created and evaluated. Thermal denaturation of collagen was confirmed by histologic analysis of excised tissues using nitro-blue tetrazolium chloride (NBTC) viability stain, hematoxylin and eosin staining, and polarized microscopy.

Summary of Results or Findings:

Lesion geometry was affected by changes in source conditions. Lower frequency ultrasound transducers produced MATRs deeper within the dermis; conversely greater frequency transducers created MATR more superficial in tissue. Longer exposure times resulted in larger cross sectional area MATRs, while short exposure times produced thinner more discrete lesions. As energy power settings were increased, ablation zones extended more superficially into the skin rather than extending damage deeper into tissue. Ultrasound imaging revealed the relative thickness of the dermis and subdermal tissues and helped provide feedback with coupling the probe to the tissues.

Statement of Conclusions Reached:

This work demonstrated that IUS was capable of producing repeatable selective MATRs within the deep dermis while sparing the overlying epidermis. Ultrasound imaging was helpful for treatment planning by evaluating soft tissue layers. Further experiments are necessary to evaluate the safety and efficacy of IUS facial skin treatment.

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