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Combined HIFEM and Synchronized RF Heating in MASLD: A Non-Invasive Strategy to Reduce Hepatic Fat and Improve Metabolic Parameters

Abstract:

Background: Metabolic-associated liver disease (MASLD) is driven by excess visceral/ectopic fat and low muscle mass. Simultaneous high-intensity focused electromagnetic stimulation (HIFEM) with synchronized radiofrequency (RF heating) reduces adipose thickness and increases skeletal muscle thickness in controlled MRI/ultrasound studies.

Objective: By decreasing visceral/subcutaneous adiposity and improving muscle mass/function, HIFEM+RF may reduce hepatic steatosis and improve metabolic markers in MASLD.

Methods: This pilot study included 56 patients (mean age 46 ± 7 years, BMI 32.3 ± 1.7 kg/m^2) with MRI-spectroscopy–confirmed MASLD. Participants underwent 4 sessions over 3–4 weeks combining RF heating with HIFEM. Assessments before and after treatment included liver fat content (US-spectroscopy/MRI-PDFF), ALT, AST, HOMA-IR, QUICKI, waist circumference, US-derived VAT, and safety at week 12.

Results: By three months, abdominal fat was reduced by 28.3 % and muscle thickness increased by 24.2 %. At week 12: ≥4 cm waist reduction and ≥15 % VAT decrease. Hepatic fat reduction: ≥15 % relative decrease in MRI-PDFF. Biochemical/metabolic improvements included normalization of ALT/AST and GGT. Reductions in visceral fat and increases in muscle mass correlated with steatosis regression, HOMA-IR reduction ≥20 %, and QUICKI increase ≥30 %. Patient comfort and satisfaction were high; side effects were mild and transient (temporary erythema, muscle soreness).

Conclusion: Synchronous HIFEM and RF heating appears to be a safe, non-invasive modality that may reduce fat accumulation and enhance muscle adaptation, with potential relevance for MASLD management. Controlled trials are warranted to confirm specific effects on hepatic steatosis and metabolic outcomes. HIFEM+RF may represent a non-pharmacologic adjunct for MASLD by targeting ectopic fat and the muscle–liver metabolic axis.

Keywords: Metabolic-associated liver disease, HIFEM, high-intensity focused electromagnetic stimulation, RF heating