A new understanding of IFC energy transfer in tissue

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Traditionally, IFC has been used for pain management on the theoretical bases of:

- producing maximum stimulation where the two currents intersect deep in the tissue.
- minimum stimulation occurs at skin surface and outside intersection area
Background

No clear effect of IFC in pain (Beatti et al 2010, Fuentes et al 2010)

Resistance of skin and the underneath structures to electric current (Ozcan et al 2004, Sunaga et al 2002)

Lack of evidence of IFC transfer in tissue.

Does IFC reach target tissue?
Objectives

To investigate:

- **depth of penetration** of IFC through soft tissues
- **area of spread** during clinical application
Method

A laboratory based study of healthy participants

12 healthy subjects 31.67 ± 5.35 years and BMI 18-32 kg/m²

Inclusion criteria

- No pain or impairment of lower limb function
- No orthopedic or neurological pathology
- No breaks or irritation of the skin

IFC was applied to medial thigh

Induced voltage was measured via fine coated needle electrodes connected to Cambridge Electronic Design and Spike software
Method

Subjects tested on 1 occasion for 45 minutes

Three depths (skin, subcutaneous and muscle)

Three areas (middle, in line and outside the electrodes)

Four currents tested (Premodulated, true IFC 4, 40 and 90Hz)

Voltage readings taken at each tissue depth from each electrode during each tested frequency
Methods

IFC electrodes and needles placement
Results

Middle of 4 electrodes

In line with one circuit

Out side 4 electrodes
Results: Depth of penetration

Comparison of depths

Skin vs muscle P=1
Results: Area of spread

Comparison of areas

Highest volt. recorded

Lowest volt. recorded

mid vs out $P = .011$

mid vs line $P = .025$
Results

Comparison of currents

Premod. vs “true” IFC $P=.001$

40Hz vs 90Hz $P=0.047$. 
Conclusion

All tested currents passed through soft tissues and reached muscle tissue.

For each frequency of “true” IFC, the voltage was higher in the skin outside the electrodes. Not in muscle at crossing point

Premodulated had higher voltages recorded from the subcutaneous in the line with one circuit.

Further studies with larger sample size are required to confirm the results of this study.
Clinical significance

Clinical evidence based of the penetration of the IFC to reach target tissue for treatment purposes

If pain management depends on the amount of voltages inside the tissue then:

- the crossing application method IFC is not the best way to apply IFC
- beat frequency of 4Hz is most efficient
- premodulated is less effective when targeting deeper tissue.
Thank you