Electrically Induced Osteogenesis: Relationship of Current Density to Quantity of Bone Formed.

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Question # 1:

What is the effective current density for stimulation of osteogenesis at the bare wire/insulation interface?
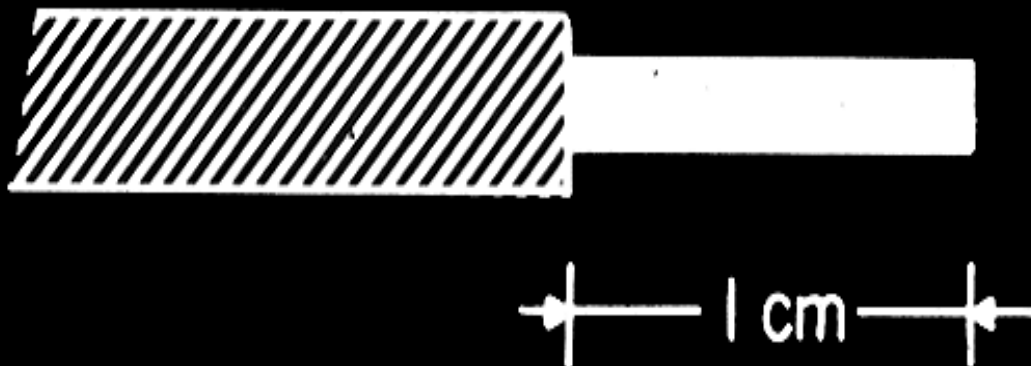
Question # 2

Can more than one of these bare wire/
insulation junctions be combined on
the same cathode to maximize the amount
of bone formed per cathode?

GROUP I

	Length of Wire (cm)	Current (μamp)	Current Density (μamp/mm^2)
Control	1.0	20	106.4
Experimental	2.0	40	212.8
Experimental	4.0	80	425.5

Control Cathode

28 gauge Multi-Strand Stainless

|←|———— I cm ————|→|

GROUP I

Percent of Medullary Canal Filled with New Bone

| | 0 | 22.9 ±4.8 | 22.7 ±7.3 | 22.3 ±2.8 | 22.3 ±5.2 | 0 | | | | | |

1cm/20 μamps

| | 0 | 33.5 ±11.4 | 31.0 ±9.6 | 24.3 ±3.9 | 24.6 ±72 | 0 | 0 | | | | |

2 cm/40 μamps

—+0.5 cm+—

| | ∅ | ∅ | ∅ | ∅ | ∅ | ∅ | ∅ | ∅ | ∅ | ∅ | ∅ |

4 cm/80 μamps

Mean ± Standard Error of the Mean

∅ = Necrosis

GROUP II

	Length of Wire (cm)	Current (μamp)	Current Density (μamp/mm^2)
Control	1.0	20	106.4
Experimental	0.5	20	106.4
Experimental	0.1	20	106.4

GROUP II

Percent of Medullary Canal Filled with New Bone
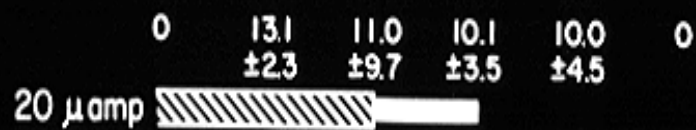
Mean ± Standard Error of the Mean

New Design Cathode – Diagrammatically

4.5 cm

2 mm

Insulated Wire

1 cm
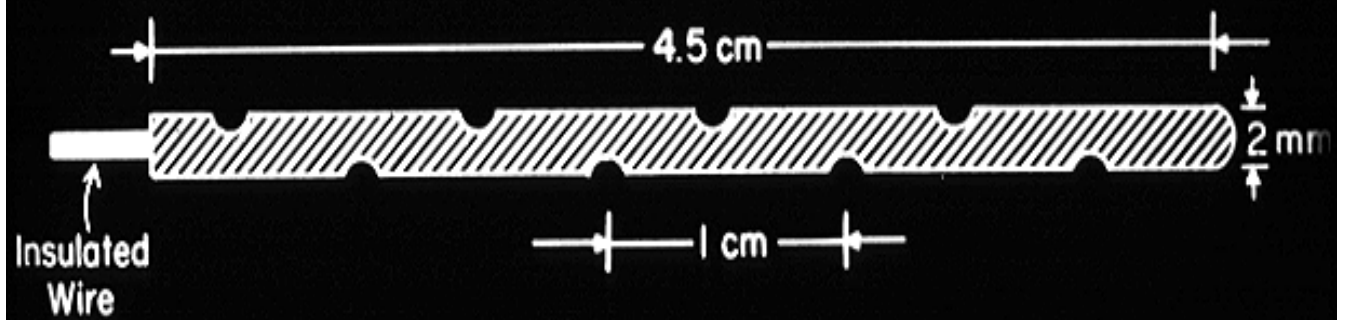
GROUP III

	Length of Wire (cm)	Current (μamp)	Current Density (μamp/mm^2)
Control	1.0	20	106.4
Experimental	8 separate ports	80	90.9
Experimental		160	181.8

GROUP III

Percent of Medullary Canal Filled with New Bone

	27.5 ±6.8	28 ±11	12.3 ±4.5	16.0 ±8.3	16.5 ±1.5	29.5 ±11.5	18 ±8.9	15 ±7.6	11.7 ±7.8	8 ±2
80-160 uamp CATHODE										

				10.5 ±4.7	18.7 ±4.2	19.2 ±4.9	19.5 ±5.8			
20 µamp CONTROL	0	0	0					0	0	0

The active surface area of a cathode is limited to an extremely small area at the insulation-bare wire junction.

Electrically-induced osteogenesis is dependent upon the active surface area of the cathode and thus, is current density dependent.

Current densities in the range of 90-200 μamps /mm^2 consistently stimulated osteogenesis.

Current densities $> 400\,\mu amp/mm^2$ = necrosis