Pressure ulcers result from Deep Tissue Damage?

Do the Math!

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Newton’s Third Law

For every action there is a equal and opposite reaction.

• Gravity pulls down
• Cushions and mattresses push up
• Soft tissue gets squeezed in the middle
Where does the damage occur?

• What causes the damage?
  • Stress
  • Strain
  • Heat
  • Ischemia
  • Reperfusion injury
  • Impaired lymphatic flow
  • None of the above
  • All of the above
Assessment of mechanical conditions in sub-dermal tissues during sitting: A combined experimental-MRI and finite element approach

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The argument for strain

Compression-induced deep tissue injury examined with magnetic resonance imaging and histology

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- Large deformation of muscle cells was associated with the location of tissue damage
Are pressure ulcers caused by deep tissue damage?

- Stress alone?
  - Evidence suggests high stress in deeper tissues but … Why is time a factor?

- Strain alone?
  - Evidence suggests higher strain in deeper tissues but … Why is time a factor?
What about Heat?

• Pressure (100 mmHg) was applied for 5-hour periods at 4 different temperatures (25°C, 35°C, 40°C, 45°C) on 16 swine
• Pressure damage severity and location after 7 days was found to be related to temperature
  • 25°C - no damage
  • 35°C - deep tissue damage
  • 40°C - deep and superficial damage
  • 45°C - more severe deep and superficial damage

All the evidence points to Ischemia

- Stress and strain occlude blood vessels (i.e. they cause ischemia)
- Heat increases metabolism exacerbates effects of ischemia
Do all pressure ulcers result from deep tissue damage?

• Most do!
  • Ischemia causes pressure ulcers
  • Stress and strain cause ischemia
  • Stress and strain appear to be greatest near bone
  • Histological studies confirm initial deep damage following contact loading
What about superficial wounds?

- Are they pressure ulcers?
- What exactly is a stage I pressure ulcer?