

Numerical Characterization of Ultrasound Elastography for the Early Detection of Deep Tissue Injuries

A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science

by

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The reasons for and goals of this research

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Estimating stiffness using manual palpation

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Using transducer-generated forces instead of manual palpation

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Quantifying tissue stiffness using shear wave speeds

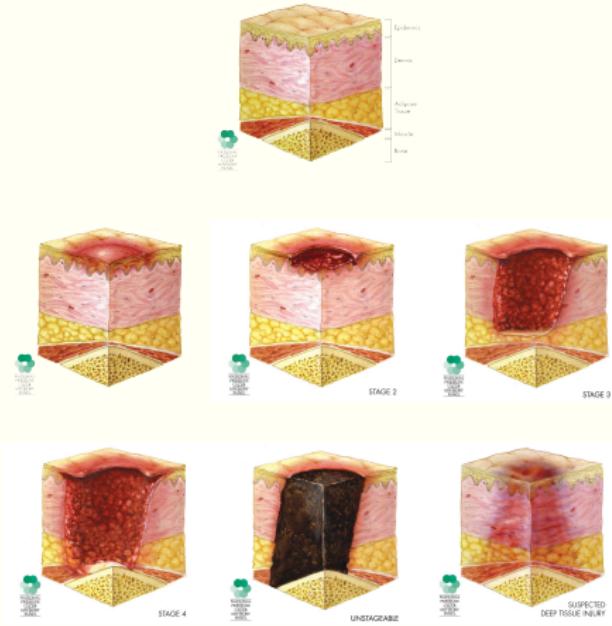
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Introduction

Pressure Ulcers

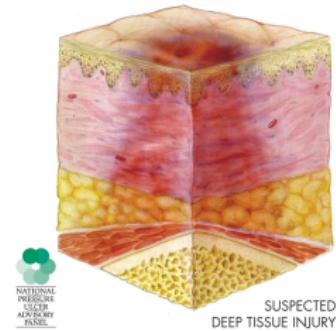
- Pressure ulcers are secondary injuries
 - People with reduced mobility
- Skin breakdown due to moisture, shear / friction
- Categorized by NPUAP in stages
 - From shallow to deep



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Deep Tissue Injuries

- Not all PU form “top-to-bottom”
 - Deep tissue injuries (DTI) form “bottom-to-top”
 - Eventually break out into stage III – IV pressure ulcers
- Tissue damage due to pressure and deformation
- Almost impossible to detect clinically



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Deep Tissue Injury Detection

- ❖ T_2^* -weighted MRI in research settings
- ❖ Risk assessment scales in clinical settings
 - ❖ Norton, Braden, and Risk Assessment Pressure Sore scales

Filling the Gaps

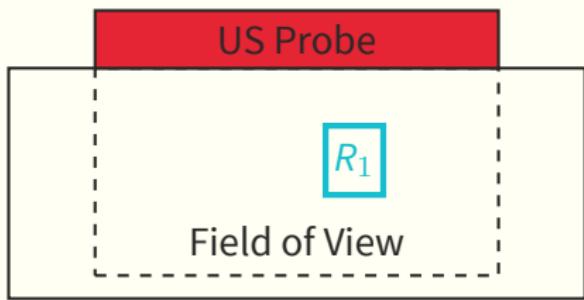
	DTI	B-Mode	QS USE	ARFI	Shear	FEM	Phantom	Animals	Humans	Characterization	Clinical
PU Risk scales	X	X	X	X	X	X	X	X	✓	X	✓
T_2^* MRI	✓	—	—	—	—	✓	✓	✓	✓	X	X
Aoi et al.	✓	✓	X	X	X	X	X	X	✓	X	✓*
Deprez et al.	✓	X	✓	X	X	✓	✓	✓	X	X	✓
This work	✓	X	✓	✓	✓	✓	✓	X	X	✓	✓

What?

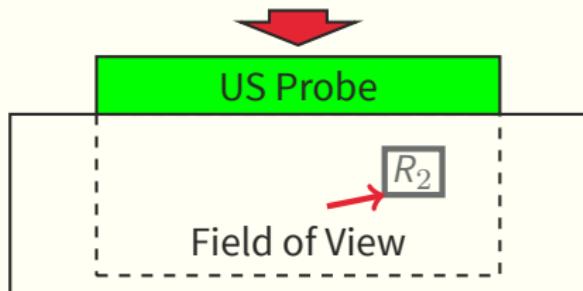
Quasi-Static Ultrasound Elastography

Introduction

- Earliest form of ultrasound elastography
- Apply manual pressure to tissue
 - Measure localized deformation of tissue
- Magnitude of deformation related to stiffness



Pre-compression image



Post-compression image

Acoustic Radiation Force Impulse Imaging

Introduction

Shear Wave Speed Quantification

Introduction

Conclusions

Comparing Methods

Recommendations

Additional Slides

Additional Slides

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