

# 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

Kenton David Hamaluik

# Contents

## 1. Introduction

The reasons for and goals of this research

## 2. Quasi-Static Ultrasound Elastography (QS USE)

Estimating stiffness using manual palpation

## 3. Acoustic Radiation Force Impulse (ARFI) Imaging

Using transducer-generated forces instead of manual palpation

## 4. Shear Wave Speed Quantification

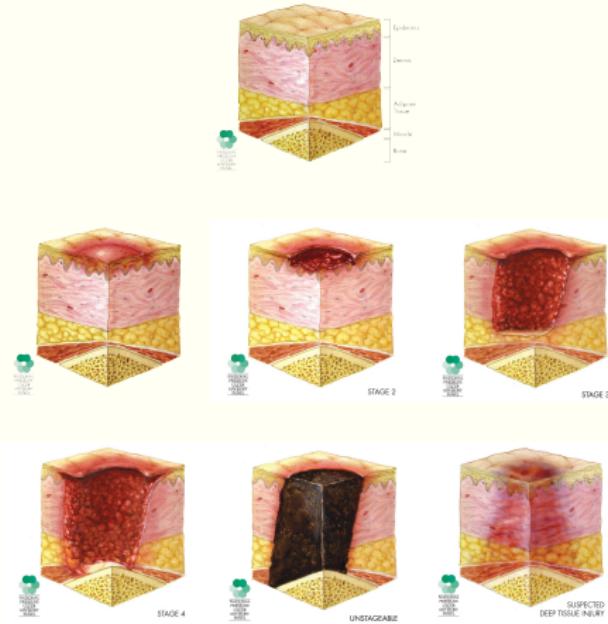
Quantifying tissue stiffness using shear wave speeds

## 5. Conclusions

Recommendations and final thoughts

# Pressure Ulcers

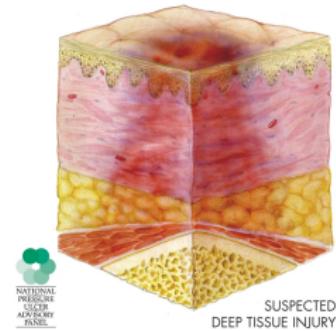
- Pressure ulcers are secondary injuries
  - People with reduced mobility
- Skin breakdown due to moisture, shear / friction
- Categorized by NPUAP in stages
  - From shallow to deep



© National Pressure Ulcer Advisory Panel, used with permission.

# 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



© National Pressure Ulcer Advisory Panel,  
used with permission.

# 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	QsUSE	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?

# Introduction

# Introduction

# Introduction

# Comparing Methods

# Recommendations

# Additional Slides

- ▶ backup 1

# backup1

herp