

# Introduction to Lumbopelvic Rehabilitative Ultrasound Imaging

## Introduction

- ❖ What is Ultrasound?
  - Ultrasound is a non-ionizing method of imaging that involves exposing the tissues to high frequency sound waves in order to produce an image of the inner body
- ❖ Uses in Physical Therapy
  - RUSI
    - MSK
    - Rehabilitative
  - Applications in Rehabilitation
    - Tissue evaluations
      - Morphology
      - Morphometry
    - Biofeedback training of motor control patterns
    - Objectify changes as a result of interventions
- ❖ Ultrasound Equipment
  - Transducer/Probe: Creates the sound waves, receives the echo
  - Controls: Keyboard and mouse, used to manipulate the image
  - Central processing unit (computer)
  - Image display
- ❖ Hardware based vs Software based systems

## Ultrasound Physics

- ❖ Pulse-echo Format:

Transducer creates short bursts (pulse) of sound waves that travel through various tissues and are reflected (echo) back at varying speeds and intensities, to the source. The transducer receives the echo and the processor digitizes the information to create an image on the screen
- ❖ Image Generation

Transducer creates the sound wave that contacts the tissues and creates an echo. The rate of echo return is analyzed and digitized by the processor and displayed on the screen
- ❖ Frequency: Measured in Hz=cycles/sec

Ultrasound is > 20 MHz  
Higher or “faster” frequency provides precise images at very shallow range  
Lower or “slower” frequencies have poorer resolution but penetrate much deeper

## Image interpretation

- ❖ Echogenicity: The capacity of a structure/tissue in the path of an US beam to reflect the sound waves
  - Hyperechoic: The structure being examined exhibits a highly reflective pattern and appears brighter than surrounding tissue
  - Isoechoic: The structure demonstrates the same echogenicity as the surrounding tissues

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- Hypoechoic: The structure exhibits a low reflective pattern therefore appears darker than the surrounding tissues
- Anechoic: The image of the structure shows no echo and is black (fluid)
- ❖ Artefact: Misleading information
  - Acoustic Enhancement: The tissues deep to a fluid filled structure (bladder) will be highlighted
  - Acoustic shadow: The tissues deep to a hyperechoic structure (bone) will be masked
  - Edge shadow: As the sound waves pass through liquid, they are bent resulting in a dark shadow at the edge where the waves are absent
- ❖ Signal Attenuation: Sound wave loss or scatter as it propagates through the tissue
  - Absorption, scattering, reflection
  - Higher frequency=increased attenuation
- ❖ Understanding what you are seeing
  - Take a slice then lift it up and look straight on
  - Orientation of the probe changes how the image appears

## Performing an Ultrasound Scan

- ❖ System operation
  - Presets
- ❖ Using the transducer
  - Standard approach
    - Anatomic landmark
    - Sonographic landmark
    - Area of interest
    - Tissue Characteristics
  - Orientation on the body
    - Scanning Planes
    - Probe positioning

## RUSI Clinical Applications

- ❖ Transabdominal
  - PFM motor control
    - Standard approach
    - Measurements
    - Patient activity
    - Clinical training
  - Pelvic Contents
    - Bowel contents, PVR
- ❖ Abdominal wall
  - Anterior abdominal wall for rectus function
    - Standard approach
    - Measurements
    - Patient activity
    - Clinical training

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- Lateral abdominal wall for transversus function
  - Standard approach
  - Measurements
  - Patient activity
  - Clinical training
- ❖ Lumbar multifidus
  - Standard approach
  - Measurements
  - Patient activity
  - Clinical training