MAGNETIC RESONANCE IMAGING VERSUS MUSCULOSKELETAL ULTRASOUND FOR IDENTIFICATION AND LOCALIZATION OF PLANTAR PLATE TEARS

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Des Plaines, Illinois
INTRODUCTION

- Trapezoidal to heart shaped structure
- Fibrocartilage
  - Type 1 collagen
    - Dorsal 2/3$r^d$s - longitudinal organization with interwoven appearance
    - Plantar 1/3$r^d$ - transverse organization, continuous with deep transverse intermetatarsal ligament
- No elastin fibers
- Historically difficult structure to image
NORMAL MRI ANATOMY

- Similar appearance on all sequences
- Broad band of decreased signal plantar to the metatarsal head and dorsal to the flexor tendons
- May be highlighted by physiologic joint fluid on T2 and STIR sequences
NORMAL MRI ANATOMY
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NORMAL ULTRASOUND ANATOMY

- **Longitudinal**
  - Grainy, echoic curvilinear structure that is adjacent to the metatarsal head
  - Flexor tendons are distinct structure

- **Transverse**
  - Less defined echoic curvilinear structure adjacent to the metatarsal head
  - Flexor tendons are a distinct overlying structure
NORMAL ULTRASOUND ANATOMY

Distal

Long flexor tendon

Superficial

Plantar plate

Proximal

2\textsuperscript{nd} proximal phalanx

2\textsuperscript{nd} met head
**PURPOSE**

- Directly compare two imaging modalities
  - Magnetic resonance imaging
  - Musculoskeletal ultrasound
- Ability to *identify* that pathology is present
- Ability to *localize* that pathology
- Intra-operative pathology
METHODS

- 51 feet, 42 consecutive patients
- Pre operatively
  - MRI
  - Musculoskeletal Ultrasound (MSK US)
- Compared to the observed intra-operative pathology
METHODS – MSK US

- Single examiner
  - Fellowship trained foot & ankle surgeon (DPM)
  - Blinded exam

- Two plane exam
  - Sagittal plane
    - Tear accuracy
    - Is a tear present?
  - Transverse plane
    - Localization accuracy
    - Where is the tear?
METHODS - MRI

- Single examiner
  - Fellowship trained MSK radiologist (MD)

- Standard plantar plate MRI
  - 0.3 Tesla extremity magnet
  - No contrast
  - 3 planes, 2 mm slices
  - MPR images, 0.2 mm slices
**RESULTS**

46 plantar plate tears were identified on intra-operative pathology

<table>
<thead>
<tr>
<th>Grade of Tear</th>
<th>Description of Tear</th>
<th>Quantity Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact</td>
<td>Plantar plate intact without pathology</td>
<td>5</td>
</tr>
<tr>
<td>Grade 0</td>
<td>Plantar plate attenuation or discoloration</td>
<td>3</td>
</tr>
<tr>
<td>Grade I</td>
<td>Transverse distal tear &lt;50% of insertion</td>
<td>0</td>
</tr>
<tr>
<td>Grade II</td>
<td>Transverse distal tear &gt;50% of insertion</td>
<td>27</td>
</tr>
<tr>
<td>Grade III</td>
<td>Transverse and/or longitudinal extensive tear (may involve collateral ligaments)</td>
<td>13</td>
</tr>
<tr>
<td>Grade IV</td>
<td>Extensive tear with button hole (dislocation)</td>
<td>0</td>
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<td>84.5% (17/19)</td>
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<td>82.4% (14/17)</td>
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<td>--------</td>
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## Discussion

**MRI**
- Detected 22/23 tears
- Falsey reported 1 tear
- Failed to detect 1 tear
- Sensitivity 96%
- Specificity 0%
- Positive Predictive Value 96%
- Negative Predictive Value 0%
- Overall accuracy 92%

**Ultrasound**
- Detected 23/23 tears
- Failed to detect 1 tear
- Sensitivity 100%
- Specificity 0%
- Positive Predictive Value 96%
- Negative Predictive Value 0%
- Overall accuracy 96%

DISCUSSION

- MRI has been found to be highly sensitive and highly specific.
  - Sensitivity 95%
  - Specificity 100%
  - Positive predictive value 100%
  - Negative predictive value 67%
  - Accuracy 96%

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- Both modalities are sensitive
- MRI is much more specific
  - Ability to detect collateral ligament pathology
CONCLUSION

- Both MRI and US are appropriate imaging modalities when the anatomy is understood by both the technologist and the radiologist.

- Both modalities can identify and localize plantar plate pathology.
CONCLUSION

- Ultrasound should not replace MRI in all cases
  - Specificity of MRI is 100%
  - Plantar plate imaging adequate
  - Other soft tissue structure imaging inadequate
  - HIGHLY technician dependant
REFERENCES


Thank you!

Contact Information:
Eek@weil4feet.com
@ErinEve27 @weil4feet
www.weil4feet.com
Disruption of plantar plate

Capsulitis (65.2%)

Joint effusion (39.1%)

Neuroma (35.2%)

LCL injury (20.3%)