Inter-Rater Reliability of Measurement of TT-TG and Trochlear Morphology on MRI: The Effect of Axial Slice Selection

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Disclosures

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Introduction

• Patellar instability is a frequent cause of knee dysfunction in young active patients.
• Anatomic factors are felt to contribute to patellar instability and may influence treatment
  – Patellar Height
  – Tibial tubercle-trochlear groove (TT-TG) distance
  – Trochlear morphology (trochlear depth and sulcus angle)
• TT-TG distance and trochlear morphology are frequently assessed on axial MRI images
• We hypothesized that inter-rater reliability of these measures is good and that inter-rater variation is driven primarily by axial slice selection.
Methods – Slice Selection

• Six raters (two sports medicine fellowship-trained orthopaedic surgeons and four orthopaedic sports medicine fellows) reviewed axial MRI images from each patient

• Each rater was instructed to identify the femoral and axial slice that they would use to measure the TT-TG distance and measure trochlear morphology

• Raters were instructed to choose¹
  – The most proximal femoral axial slice on which the full width of the trochlea was covered with articular cartilage
  – The most proximal tibial axial slice on which attachment of the patellar tendon to the tibia was noted
Methods -

• Each rater measured and recorded the
  – TT-TG distance
  – Trochlear depth
  – Trochlear sulcus angle
  – Tibial and femoral slices utilized for the measurement

• Each rater then repeated the measurement using pre-selected femoral and tibial slices
Methods

• Inter-rater reliability was calculated by inter-class correlations (ICCs)
  – Femoral and tibial slice selection
  – TT-TG distance
    • With both independent and predetermined slice selection
  – Trochlear morphology measures
    • With both independent and predetermined slice selection
• Intra-rater reliability was assessed for three raters who repeated each measure
• Statistically significant differences (p < 0.05) in ICC based on slice selection were defined as those values without overlap of their 95% confidence internals.
Results – Inter-rater Reliability

• Inter-rater reliability was noted to be excellent (ICC $\geq$ 0.80)

<table>
<thead>
<tr>
<th>Table 1 – Inter-Rater Reliability</th>
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<tbody>
<tr>
<td>ICC (95% CI)</td>
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<td>Predefined slices</td>
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<tr>
<td>Tibial Axial Slice</td>
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<tr>
<td>Femoral Axial Slice</td>
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<tr>
<td>TT-TG Distance</td>
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<tr>
<td>Sulcus Angle</td>
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<tr>
<td>Trochlear Depth</td>
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</table>

• Inter-rater reliability for sulcus angle was noted to be significantly improved (p < 0.05) with predetermined slice selection
Results – Range of Measurements

Mean range of measurements was noted to decrease with the use of predetermined slices

<table>
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<tr>
<th>Table 2: Mean Range of Measurements</th>
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<tr>
<td><strong>Independent Slice Selection</strong></td>
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<td>Mean Range</td>
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<td><strong>Tibial Axial Slice</strong></td>
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Discussion

• Key findings:
  – Inter-rater reliability of MRI slice selection for quantitative measurements related to patellar instability are generally good
  – Improvement in slice agreement does improve the inter-rater reliability of *trochlear sulcus angle*

• The inter-rater reliability of trochlear depth remains only fair – even when variation due to slice selection is removed

• The inter-rater reliability of TT-TG distance was good regardless of whether independently selected or pre-selected MRI slices were used for measurement
  – Probably due to the relatively small effect of slice selection on the position of the trochlear groove
The effect of one slice

- Figure shows the effect of moving one slice distally of axial MRI, resulting in a 16 degrees change in sulcus angle but minimal change in trochlear groove position.
Discussion

• This method of axial femoral slice selection was described by Schottle et al\textsuperscript{1} and has been utilized by many other authors.

• Other methods have been described:
  – The “axial image with the greatest anterior–posterior diameter of both femoral condyles”\textsuperscript{2}
  – The “image representing the best roman arch”\textsuperscript{3}
  – The "image in which the trochlear groove appeared to be the deepest while remaining fully defined"\textsuperscript{4}

• Further work is required to assess the impact of slice selection of measurements of interest utilizing variable techniques for slice selection.
Conclusion

- Inter-rater reliability of TT-TG distance is good and not highly dependent on slice selection on MRI
- Inter-rater reliability of trochlear morphology measures based on axial MRI slices and is fair
- Inter-rater variation can be reduced in the case of sulcus angle through improved agreement on slice selection
References


