MRI review of traumatic avulsions of the proximal adductor longus in athletes. Classification of different types of fibrocartilage injuries.

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Adam WM Mitchell
Corresponding Author
adam.mitchell@fortiusclinic.com

fortius clinic
Excellence in orthopaedic and sports injury treatment
Authors

Justin Lee  
Chelsea and Westminster Hospital

Ernest Schilders  
Fortius Clinic

Mattias Spaepen  
Sint-Trudo Hospital

Alexandra Dimitrakopoulou  
The London Hip Arthroscopy Centre

John Ian McGuinness  
Aspetar Orthopaedic and Sports Medicine Hospital

Carlton Cooke  
Carnegie Faculty, Leeds Trinity University
Disclosures

• Financial
  Ernest Schilders
  Adam Mitchell
  Justin Lee

• Non Financial
  Nil

Shareholders in Fortius Clinic
Objectives

To review retrospectively MRI scans of a cohort of athletes who sustained traumatic fibrocartilage injuries of the adductor longus and to determine different types of fibrocartilage avulsions and propose a classification system.
Background

• Proximal adductor longus avulsions are rarely reported injuries

• There is still debate if surgical or conservative treatment provides the best outcomes and the fastest return to sport

• The absence of a standard imaging protocol designed to evaluate traumatic proximal adductor longus avulsions and a classification system is one of the reasons why this controversy is still ongoing
The Fibrocartilagenous Enthesis

- Contains four zones of tissue: dense fibrous connective tissue with its typical fibroblasts, zones of uncalcified and calcified fibrocartilage that contains fibrocartilage cells and bone.

- The footprint of the fibrocartilage measures approximately 1.5 x 2.5 cm and has a triangular shape or shark fin appearance on sagittal views.

- The adductor longus contains tendinous fibres on the anterior surface, while the posterior surface consists mainly of muscle tissue.
Strain vs. Avulsion at the musculotendinous junction

Because of its anatomy and variations in the musculotendinous junction strain cannot always clinically be distinguished from an avulsion of the fibrocartilage of the adductor longus and therefore requires ultrasound imaging or MRI.
The aim of the study is to review MRI images of a cohort of athletes who sustained acute traumatic avulsions of the fibrocartilagenous enthesis of the adductor longus and to propose a classification system.
Methods

• All the patients seen with adductor longus avulsion are routinely enrolled in a database at our centre.

• We retrospectively reviewed the MRI scans of a cohort of athletes who sustained an acute injury to the adductor longus enthesis.

• We retrospectively reviewed the MRI scans of a cohort of athletes who sustained an acute injury to the adductor longus enthesis.

• The same clinician assessed all the athletes.

• Specific imaging protocol when there is a clinical suspicion of a traumatic adductor longus proximal avulsion.

• Athletes with acute adductor enthesis avulsions who were not imaged with our standard MRI protocol or equivalent MRI protocol were excluded from the study.

• All the MRI scans reviewed demonstrated an avulsion injury of the fibrocartilage of the adductor longus.
Imaging technique

• MR imaging examinations were performed on a 1.5 T system (Intera, Philips, Best, Netherlands/Avanto, Siemens, Germany)
Imaging technique

• Axial oblique T1 weighted turbo spin echo (TSE) sequence (TE:12 and TR:500)

• Axial oblique T2 weighted TSE fat suppressed (fs) sequence (TE:100, TR:4000). Three millimetre slice thicknesses were obtained parallel to the superior aspect of the symphysis pubis and superior rami (Figure 1).

• Sagittal T1 weighted TSE and sagittal T2 weighted fs sequences were also obtained. The sagittal sequences with three millimetre slice thickness were obtained starting from the symphyseal disc and moving laterally bilaterally (Figure 1)
The sagittal images

The sagittal cuts allow a view of the anteroposterior dimensions of the fibrocartilage moving from central to lateral and is used to measure distal displacement of the fibrocartilage when present.
Imaging technique

The Shark’s fin
Axial oblique images

Demonstrating the anteroposterior and mediolateral dimensions of the fibrocartilage moving from cranial to caudal and is used to measure lateral and anterior displacement
Imaging technique

Oblique axial
Key point

When the fibrocartilage avulses it displaces laterally, distally and anteriorly.
Image scoring

• 1 surgeon
• 2 radiologists
Statistical methods

• Inter-rater reliability was used to examine the agreement between raters on the assignment of categories (i.e. a categorical variable).

• The ratings of three observers were compared across the six categories of the rating scale defined in this study using Cohen’s Kappa calculated in SPSS 21.

• Each pair of raters was compared and the overall inter rater reliability was calculated by taking the arithmetic mean of the kappa coefficient for each of the three pairs of raters. Inter-rater agreement is poor for a Kappa <0.21, moderate 0.21-0.40, substantial 0.61-0.80 and excellent for >0.81.

• The study was a clinical audit and performed according to the guidelines of the Medical Research Council.
Results

- Fifty-one MRI scans of athletes with traumatic fibrocartilage avulsions of the adductor longus were reviewed.

- Fifteen patients were excluded because they did not have the correct MRI protocol leaving 36 in the study.

- The average age of the athletes was 37.7 years (range 21-61 years).

- The majority of athletes were professional soccer players (50%).
## Athletes and sport

<table>
<thead>
<tr>
<th>Sport</th>
<th>Performance Level</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>soccer</td>
<td>Professional</td>
<td>18</td>
</tr>
<tr>
<td>soccer</td>
<td>Recreational</td>
<td>13</td>
</tr>
<tr>
<td>tennis</td>
<td>Professional</td>
<td>1</td>
</tr>
<tr>
<td>ski</td>
<td>Recreational</td>
<td>1</td>
</tr>
<tr>
<td>rugby</td>
<td>Professional</td>
<td>1</td>
</tr>
<tr>
<td>Horse riding</td>
<td>recreational</td>
<td>1</td>
</tr>
</tbody>
</table>
Results

• The median time from injury to scan was less than 1 month.

• The site of the avulsions corresponded 100% with the site of clinical adductor related symptoms after the injury.

• The MRIs were scored the experts agreed on six different types of traumatic adductor longus fibrocartilage avulsions.
# Classification of Avulsions

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>Complete avulsion with displacement</td>
</tr>
<tr>
<td>IB</td>
<td>Complete avulsion without displacement</td>
</tr>
<tr>
<td>IC</td>
<td>Complete avulsion without displacement + secondary cleft sign</td>
</tr>
<tr>
<td>IIA</td>
<td>Partial avulsion with displacement</td>
</tr>
<tr>
<td>IIB</td>
<td>Partial avulsion without displacement</td>
</tr>
<tr>
<td>IIC</td>
<td>Partial avulsion without displacement + secondary cleft sign</td>
</tr>
</tbody>
</table>
1A. Complete avulsion and displacement
1B. Complete Avulsion without displacement
1C. Complete Avulsion without displacement and secondary cleft
2A. Partial avulsion with displacement

The sagittal series confirm the partial avulsion
2B. Partial Avulsion without displacement
2C. Partial Avulsion without displacement and secondary cleft
The frequency of occurrence of avulsions by type in the three raters.

<table>
<thead>
<tr>
<th>Type</th>
<th>Rater A</th>
<th>Rater B</th>
<th>Rater C</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>IB</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>IC</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>IIA</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>IIB</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>IIC</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Themes

• The most common type was the complete avulsion of the fibrocartilage with displacement in 52.7 % (n=19) of the athletes

• Thirty-five and half % (n=12) of the athletes had partial avulsions, all anatomically located on the lateral aspect of the fibrocartilage
Broken Butterfly wing sign
## Statistical Results

### Inter-rater reliability scores

<table>
<thead>
<tr>
<th>Rater pair</th>
<th>Kappa (p value)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>A and B</td>
<td>0.916 (P&lt;0.001)</td>
<td>0.806 - 1.00</td>
</tr>
<tr>
<td>A and C</td>
<td>0.874 (P&lt;0.001)</td>
<td>0.743 - 1.00</td>
</tr>
<tr>
<td>B and C</td>
<td>0.874 (P&lt;0.001)</td>
<td>0.745 - 1.00</td>
</tr>
</tbody>
</table>
Discussion points

• The inter-rater agreement in our study is excellent and demonstrates that the proposed MRI technique is accurate for assessment of secondary cleft sign, displacement and partial or full thickness avulsions to assess acute fibrocartilage lesions of the adductor longus.

• Not only is there an excellent inter-reliability between experts but also between experts and non-experts.

• With our MRI technique acute adductor longus avulsions either partial or complete can easily be diagnosed and classified.

• Optimal visualization of the fibrocartilage was obtained on the sagittal and axial oblique image.
Partial tears (Key Point)

In acute avulsions of the fibrocartilage of the adductor longus, the avulsion is always from lateral to central but often not reaching the symphyseal cleft (Image 4).

In the type of partial fibrocartilage avulsion with secondary cleft sign, the partial tear is on the lateral aspect of the fibrocartilage, whilst the secondary cleft extending from the central cleft is medial. (Image 4)
Partial tears (Key Point)

Partial tear  Secondary cleft

4A

4B
Strengths and limitations

A limitation of the study is the relatively small sample size. It is however the largest series of proximal adductor longus avulsions in the literature.

The study does not have a control group and in addition we do not have a gold standard to compare our recommended protocol too.
CONCLUSIONS

• We recommend that patients with an acute traumatic adductor longus injury should undergo an MRI with the recommended protocol.

• Our proposed classification and “broken butterfly wing sign” can be used as a tool for radiologists to report MRI scans of patients with acute fibrocartilage avulsions and aid in the interpretation of MRI scans of patients with acute groin pain.

• The use of our classification system can assist with the decision making and consensus on treatment of these injuries. It will also help with the diagnosis of partial avulsions of the fibrocartilage an often underdiagnosed condition but responsible for continuing adductor related groin pain.

• We also propose the “broken butterfly wing” sign as a pathognomonic sign for acute avulsions of the fibrocartilage of the adductor longus.
References

References


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