What is the most effective MRI specific findings for lateral meniscus posterior root tear in ACL injuries

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I have no financial conflicts to disclose.
Introduction

*Lateral meniscus posterior root tear (LMPRT)*

- LMPRT occurs in 6 - 10% of anterior cruciate ligament (ACL) injuries.\(^1\)\(^-\)\(^2\)
- LMPRT causes loss of hoop function and possible osteoarthritic change.\(^3\)

- An early repair of LMPRT may contribute to successful healing of the meniscus.\(^3\)-\(^4\)
- Accurate detection of LMPRT enables better preoperative planning and therefore preparation of the necessary instrument.

**An accurate preoperative diagnosis for LMPRT is important.**
The most reliable magnetic resonance imaging (MRI) cut for detecting meniscus root tears remains controversial \(^5\).

It is difficult to detect LMPRT based on MRI-specific findings such as the cleft, truncated triangle, and ghost signs due to their relatively low sensitivities when used alone \(^6\)-\(^8\)).

Their utility when used in combination remains unclear.

The greater force results in greater bone contusion around the knee and is associated with greater meniscus injury \(^9\).

Bone bruising may be a supplementary marker that assist in LMPRT detection.
The purposes of this study were to investigate

1) the effectiveness of MRI findings in evaluations of LMPRT in ACL injury

2) the relationship between LMPRT and bone bruising
Materials and Methods

We retrospectively assessed 231 patients who underwent primary ACL reconstruction between February 2010 and June 2018.

Exclusion criteria

- Concomitant posterior cruciate ligament injuries
- History of meniscus tear surgical treatment
- Discoid meniscus
- Severe medial collateral ligament or posterolateral complex injuries requiring operative treatment

The clinical information

Sex, age, body mass index (BMI), time from injury to MRI, and time from MRI to surgery between LMPRT and no LMPRT groups were assessed.
LMPRT was defined as a radial tear within 10 mm from the lateral meniscus posterior root attachment\textsuperscript{10).}

LMPRT was diagnosed when arthroscopic ACL reconstruction was performed.
Materials and Methods

The MRI findings

✓ T2* and T2 fat suppression images in the coronal and sagittal planes with a slice thickness of 4 mm were obtained from all patients.

- The cleft sign (on coronal plane images)
- The ghost sign (on sagittal plane images)
- The truncated triangle sign (on sagittal plane images)
- Bone bruising (on sagittal plane images)

1. The sensitivity, specificity, and accuracy of these signs, both individually and in combination, were evaluated by comparing the findings to the gold standard of arthroscopic findings.

2. The number of bone bruises occurring in the medial or lateral condyles of the femur or the tibia were assessed.
Results

Of 231 ACL-injured knees, 104 knees (45%) were complicated with a lateral meniscus tear.

- Longitudinal tear: 61 knees (26.4%)
- LMPRT: 32 knees (13.9%)
- Non-LMPRT radial tear: 10 knees (4.3%)
- Horizontal tear: 2 knees (0.9%)

The clinical information

<table>
<thead>
<tr>
<th></th>
<th>LMPRT group (n = 32)</th>
<th>no LMPRT group (n = 199)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (M: F)</td>
<td>18 : 14</td>
<td>108 : 91</td>
<td>0.835</td>
</tr>
<tr>
<td>Age (year)</td>
<td>22.1 ± 10.3</td>
<td>25.6 ± 11.3</td>
<td>0.044</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.5 ± 3.8</td>
<td>23.0 ± 3.3</td>
<td>0.476</td>
</tr>
<tr>
<td>The time from injury to MRI (day)</td>
<td>52 ± 54 (1-215)</td>
<td>66 ± 63 (0-322)</td>
<td>0.214</td>
</tr>
<tr>
<td>The time from MRI to surgery (day)</td>
<td>11 ± 16 (1-62)</td>
<td>19 ± 29 (1-195)</td>
<td>0.195</td>
</tr>
<tr>
<td>The number of bone bruise</td>
<td>3 ± 1</td>
<td>2 ± 2</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The Mann-Whitney U-test was used (P < 0.05)

In the LMPRT group, there was a tendency towards younger age and increased bone bruising.
## Results

### The sensitivity, specificity, and accuracy of three specific signs both individually and in combination

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cleft sign</td>
<td>65.6</td>
<td>95.5</td>
<td>91.3</td>
</tr>
<tr>
<td>ghost sign</td>
<td>34.4</td>
<td>97.0</td>
<td>88.3</td>
</tr>
<tr>
<td>truncated triangle sign</td>
<td>59.4</td>
<td>94.0</td>
<td>89.2</td>
</tr>
<tr>
<td>cleft sign + ghost sign</td>
<td>71.9</td>
<td>92.3</td>
<td>90.5</td>
</tr>
<tr>
<td>ghost sign + truncated triangle sign</td>
<td>81.3</td>
<td>91.5</td>
<td>90.0</td>
</tr>
<tr>
<td>cleft sign + truncated triangle sign</td>
<td>78.1</td>
<td>92.4</td>
<td>90.5</td>
</tr>
<tr>
<td>one of the three specific signs</td>
<td>84.4</td>
<td>90.5</td>
<td>89.6</td>
</tr>
</tbody>
</table>

While the specificities of the cleft, ghost, and truncated triangle signs in LMPRT detection were high, their sensitivities were low.

Sensitivity and specificity when at least one of these signs were positive were both high.
Results

The location of bone bruising

<table>
<thead>
<tr>
<th></th>
<th>LMPRT group (n = 32)</th>
<th>no LMPRT group (n = 199)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lateral compartment</td>
<td>28 (87.5%)</td>
<td>129 (64.8%)</td>
</tr>
<tr>
<td>medial compartment</td>
<td>17 (53.1%)</td>
<td>50 (25.1%)</td>
</tr>
</tbody>
</table>

✓ Bone bruising involving the medial compartment which can result from contrecoup impact suggest a high-energy injury \(^9\).

✓ Severe lateral bone contusions are significantly associated with concomitant lateral meniscal lesions in ACL injuries \(^10\).

LMPRT should be suspected with higher-energy injuries that present with a large number of condyles with bone bruising.
Conclusions

✓ Though the specificity of MRI-specific signs individually of LMPRT were high, the sensitivity was low.

✓ When at least one of these signs were positive, LMPRT was detected with adequate sensitivity and specificity.

✓ LMPRT should be suspected with higher-energy injuries that present with a large number of condyles with bone bruising.

It is important to evaluate MRI findings in both the coronal and sagittal planes when assessing LMPRT in ACL injury.


