The Pelican Sign: Case Series Demonstrating A Unique Description of an Anteriorly Flipped Bucket-Handle Meniscal Tear of the Knee

Ali Shah1  Karthikeyan P. Iyengar2  Sai Niharika Gavvala3  Amit Shah4  David Beale5  Rajesh Botchu1

1 Department of Musculoskeletal Radiology, Royal Orthopaedic Hospital NHS Foundation Trust, Birmingham, United Kingdom
2 Southport and Ormskirk Hospital NHS Trust, Southport, United Kingdom
3 Department of Radiology, Kurnool Medical College, Kurnool, Andhra Pradesh, India
4 Department of Musculoskeletal Radiology, University Hospitals of Leicester, Leicester, United Kingdom
5 Heath Lodge Clinic, Knowle, United Kingdom

Address for correspondence Rajesh Botchu, MBBS, MS (Orth), MRCSEd, FRCR, Department of Musculoskeletal Radiology, Royal Orthopedic Hospital, Bristol Road South, Northfield, Birmingham B312AP, United Kingdom (e-mail: drbrajesh@yahoo.com).

Indian J Radiol Imaging 2023;33:157–161.

Abstract

Introduction  Bucket-handle tears (BHTs) of the menisci are not uncommon and can occur in isolation or in conjunction with other injuries. The torn fragment can be displaced within the intercondylar notch or flipped anteriorly. In case of anterior flipped fragment, appearances of such tears on magnetic resonance imaging (MRI) scan have been described as various signs in literature (for example double posterior cruciate ligament sign, double delta sign) but mostly in the sagittal or coronal planes.

Purpose  The aim of this study was to describe a unique ancillary sign that helps to identify this injury on the axial MRI plane where the anterior flipped BHT figuratively resembles a “pelican bird.”

Materials and Methods  A retrospective review of MRI sequences of 10 consecutive patients over a 3-month period referred following a traumatic knee injury with anterior flipped meniscal tears was performed. Demographic details, clinical indication, and other associated features on the MRI were correlated following the observation of characteristic MRI appearance of a BHT.

Results  All 10 patients (M:F = 7:3) with a mean age of 24.7 (17–38 years) presented following a twisting injury. 6 out of 10 patients had associated soft-tissue injuries in the knee visualized on the MRI. All patients demonstrated the distinctive “pelican bird” sign on the axial sequences of anterior flipped BHT of either menisci. This was not present with BHTs with displaced fragment within the intercondylar notch.

Conclusion  We conclude that the “pelican sign” on an axial sequence when present correlates well with a BHT and its anterior displaced/flipped meniscal fragment. This ancillary sign can complement other previously described signs on different MRI sequences used to confirm a displaced BHT.
Description of the Pelican Sign on Axial MRI Sequences

The “pelican sign” is seen on axial fluid-sensitive MRI sequence in patients with anterior flipped meniscal tear. The beak of the pelican is formed by the fibrillar pattern of the anterior horn of lateral meniscus or the medial meniscus along with the intermeniscal ligament. The head and neck of the pelican correspond to the anterior half of the body of lateral or medial meniscus. The anterior flipped posterior horn of the meniscus along with medially displaced posterior or half of the body of the meniscus forms the superior and anterior part of the body of pelican. The appearance of rest of the body is due to central portion of the tibial plateau (∆Figs. 1 and 2).

Materials and Methods

Study Design and Patients

Following local hospital committee ethical approval, a retrospective evaluation of our Radiology Information System and Picture Archiving and Communication System was performed to identify 10 consecutive patients with BHT of the menisci on conventional MRI protocol (including proton density [PD] fat sat coronal, PD fat sat sagittal, PD axial, and T1 coronal sequences) with a slice thickness of 3 mm at our center for traumatic knee injuries.

We identified cases of BHTs specifically with anterior flipped fragments that were confirmed on the sagittal MRI sequences.

Inclusion Criteria

• Young-to-middle-aged male or female patients (cutoff age 50 years).
• Traumatic knee injury.
• Suspected meniscal tear on clinical review/referral.
• BHTs of medial or lateral meniscus on MRI.

Exclusion Criteria

• Age more than 50 years.
• Previous history or imaging confirming degenerative changes and/ or degenerative meniscal tears.
• Prior history of arthroscopy or surgical intervention including partial meniscectomy.

Image Analysis

• All images were reviewed independently by two musculoskeletal radiologists and an orthopaedic surgeon (AS, RB, and KI).
• Standard sequences were obtained for all cases including PD fat sat coronal, PD fat sat sagittal, PD axial, and T1 coronal sequences.

Results

All (n = 10) presented following a twisting injury. There were seven males and three females with mean age of 24.7 years (17–38 years). Demographic details, clinical characteristics,
and MRI findings of 10 patients with pelican sign are summarized in Table 3. There were seven cases of lateral and three cases of medial meniscus tears. Additional internal ligament injuries included five cases of ACL tears, with 60% associated with lateral meniscus. These were compared with 10 additional cases of BHT of meniscus where the meniscal fragment was in the intercondylar notch. Pelican sign was absent in all of these cases. The pelican sign was identified with robust inter- (100%) and intraobserver reliability (100%) in all cases of anterior flipped BHTs among the readers (Fig. 3).

### Table 1 Traditionally described signs of bucket-handle meniscal tears of the knee on MRI

<table>
<thead>
<tr>
<th>Name</th>
<th>MRI sequence</th>
<th>Description</th>
<th>Significance/Assesses</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagittal views</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Absent bow tie sign</td>
<td>Standard sagittal images</td>
<td>Should reveal the body of the meniscus on two successive cuts as a &quot;Bow Tie.&quot; When only one or no body segment is seen it is the &quot;Absent bow tie sign&quot;</td>
<td>Displaced BHT of the meniscus</td>
<td>Helms et al¹⁰</td>
</tr>
<tr>
<td>2 Double PCL sign</td>
<td>A low signal band</td>
<td>Parallel and anterior to the PCL caused by a displaced BHT displacing in the intercondylar notch</td>
<td>Almost exclusively with BHT of the MM</td>
<td>Wright et al⁸, Singson et al¹²</td>
</tr>
<tr>
<td>3 The flipped meniscus sign</td>
<td>The meniscal fragments</td>
<td>In the BHT rather than migrating toward the intercondylar notch, move anteriorly to sit directly on the anterior horn of the ipsilateral meniscus (LM or MM) meniscus</td>
<td>Displaced BHT of the meniscus</td>
<td>Haramati et al⁹</td>
</tr>
<tr>
<td>4 The double flipped meniscus sign</td>
<td>Displaced double</td>
<td>Longitudinal tear of the LM and locked within the intercondylar notch</td>
<td>Displaced double BHT of the LM</td>
<td>Ahn et al¹¹</td>
</tr>
<tr>
<td>5 The double ACL sign</td>
<td>A BHT of LM with a fragment</td>
<td>Entrapped behind and parallel to the ACL appearing as another ACL</td>
<td>Displaced BHT of either LM or MM</td>
<td>Takayama et al¹³, Al-Ahaidib et al¹⁴</td>
</tr>
<tr>
<td>6 Double delta sign</td>
<td>A BHT in which the inner</td>
<td>Meniscal fragment is flipped anteriorly adjacent to the anterior horn of the ipsilateral meniscus</td>
<td>Displaced BHT of either LM or MM</td>
<td>Haramati et al⁹</td>
</tr>
</tbody>
</table>

| Coronal views                     |                             |                                                                                                                              |                                                                                     |                                               |
| 1 Coronal truncated meniscus sign | Coronal fast spin echo     | T2-weighted MR image with fat saturation                                                                                      | Displaced BHT of either LM or MM                                                    | Dorsay and Helms¹                              |

| Axial views                       |                             |                                                                                                                              |                                                                                     |                                               |
| 1 V-sign                          | The acute angle created    | Seen in BHT meniscal tears at the junction of the flipped meniscal fragment with the ipsilateral meniscus in place                                                              | Displaced BHT of either LM or MM                                                    | Rao et al¹⁵                                    |

Abbreviations: ACL, anterior cruciate ligament; BHT, bucket-handle tear; LM, lateral meniscus; MM, medial meniscus; MRI, magnetic resonance imaging; PCL, posterior cruciate ligament.

### Table 2 Sensitivity and specificity of signs describing bucket-handle meniscal tears of the knee on MRI

<table>
<thead>
<tr>
<th>MRI sign</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent bow tie</td>
<td>88.4</td>
<td>64.3</td>
</tr>
<tr>
<td>Double PCL</td>
<td>32.6</td>
<td>100</td>
</tr>
<tr>
<td>Coronal truncation</td>
<td>65.1</td>
<td>71.4</td>
</tr>
<tr>
<td>Flipped meniscus sign</td>
<td>60.5</td>
<td>89.7</td>
</tr>
<tr>
<td>Double delta</td>
<td>76.7</td>
<td>82.1</td>
</tr>
<tr>
<td>Flipped fragment in Intercondylar notch</td>
<td>76.7</td>
<td>82.1</td>
</tr>
</tbody>
</table>

Abbreviations: MRI, magnetic resonance imaging; PCL, posterior cruciate ligament.

Fig. 1 PD fat sat axial (A) showing anterior flip tear of medial meniscus with pelican sign (B).
**Discussion**

BHTs are an important and not infrequent type of injury.\(^1\) They can be associated with pain and disability and often require surgical intervention. MRI has been shown to be accurate and preferable to diagnostic arthroscopy as a first line of investigation given its noninvasive nature and avoidance of surgery associated complications.\(^1,7\)

Many visual aids and signs on various MRI sequences have been reported in literature to identify this injury. These describe characteristic imaging appearances of a displaced fragment of the torn meniscus and considered to be reliable signs of a BHT.\(^1,9,15\) Studies have also been performed to evaluate the sensitivity and specificity of the various signs seen on MRI scans, most of which are visualized either in the coronal or the sagittal plane.\(^1\) However, some of these signs are not without caveats, for example, the “absent bow tie” sign that can also be present with a radial meniscal tear or in patients with postmeniscectomy features or in severe degenerative arthritis.\(^1\) Furthermore, to date there is only a solitary morphological sign described on an axial MRI sequence reported in literature as the “V” sign.\(^15\) Similar to these authors we agree that identification of BHTs, despite the visual aids, can be difficult, and the anterior displaced fragment being very thin may not be fully visible on the coronal or sagittal planes.\(^15\) Therefore, having an adjunct to reporting on axial sequences would increase the specificity of identifying this pathology, especially in conjunction with other associated reported signs.\(^1\) As Dorsay and Helms suggest diagnostic accuracy can only increase when such complementary radiological signs are correlated.

**Table 3** Demographic details, clinical characteristics, and MRI findings of 10 patients with pelican sign summarized

<table>
<thead>
<tr>
<th>Patient/case number</th>
<th>Age/ Sex</th>
<th>Clinical presentation</th>
<th>Site/side / location of BHT Medial/Lateral</th>
<th>Associated injuries on MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23/M</td>
<td>Football, twisting injury</td>
<td>Knee/R/LM</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>25/M</td>
<td>Football, twisting injury</td>
<td>Knee/R/LM</td>
<td>MCL grade II sprain, ACL full thickness</td>
</tr>
<tr>
<td>3</td>
<td>33/F</td>
<td>Twisting injury</td>
<td>Knee/L/LM</td>
<td>MM posterior horn, ACL full thickness</td>
</tr>
<tr>
<td>4</td>
<td>19/M</td>
<td>Football injury</td>
<td>Knee/R/MM</td>
<td>LM horizontal, ACL full thickness, edema of popliteus, pivot shift contusions</td>
</tr>
<tr>
<td>5</td>
<td>17/F</td>
<td>Twisting injury</td>
<td>Knee/R/LM</td>
<td>No other injuries</td>
</tr>
<tr>
<td>6</td>
<td>22/M</td>
<td>Twisting injury</td>
<td>Knee/L/LM</td>
<td>ACL full thickness</td>
</tr>
<tr>
<td>7</td>
<td>21/M</td>
<td>Twisting injury</td>
<td>Knee/R/LM</td>
<td>MM</td>
</tr>
<tr>
<td>8</td>
<td>38/F</td>
<td>Twisting injury</td>
<td>Knee/L/LM</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>29/M</td>
<td>Twisting injury</td>
<td>Knee/R/MM</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>20/M</td>
<td>Twisting injury</td>
<td>Knee/R/MM</td>
<td>ACL tear</td>
</tr>
</tbody>
</table>

Abbreviations: ACL, anterior cruciate ligament; BHT, bucket-handle tear; F, female; L, left; LM, lateral meniscus; M, male; MCL, medial collateral ligament; MM, medial meniscus; MRI, magnetic resonance imaging; R, right.
Compared with “V-sign” (72%), our cohort for the unique pelican sign demonstrated 100% correlation with an anterior flipped displaced meniscal tear. This was present with both lateral and medial meniscus tears.

According to textbooks and historical data, BHTs are more common with medial meniscus. Our study found significantly more lateral meniscus tears versus medial meniscus tears (7:3) probably in keeping with the acute traumatic etiology of our cohort. Majority of the ACL injuries were associated with lateral meniscus tears (60%) that are similar to published literature.

Given the robust inter- and intraobserver reliability testifies to the strength of our finding, we wish to add this to existing library of orthopaedic and radiological literature to assist with identification and diagnosis of this specific type of BHT. This can help the treating surgeon in understanding the type and position of the tear in the knee. It can allow surgical planning (instruments, sutures) and placement of arthroscopic portals to assist operative management.

**Limitations of the Study**

We agree that considering the inherent retrospective nature of the study reduces the robustness of findings. However, with robust inter- (100%) and intraobserver reliability among the readers, it gives us confidence of replicability by other clinicians.

This radiological study was conducted at a single center. We focused exclusively on “pelican sign” without comparative assessment against different signs. Hence, we suggest further multicenter studies with larger, prospective cohorts and appropriate surgical correlation to reinforce our findings.

**Conclusion**

Anterior flip tears associated with BHTs can be difficult to identify on the coronal or sagittal plane MRI scans, especially in the context of acute traumatic injuries. The proposed “pelican sign” identifies and describes the highly specific anterior displaced fragment in a BHT with high specificity.

Its presence on axial MRI imaging would increase the confidence of the reporting radiologist in diagnosing this injury, especially when present in conjunction with other already described radiological signs for displaced BHTs.

References


Informed Consent

Informed consent (patient/guardian), mandatory only for case reports/clinical images—consent was obtained.

Author Contributions

All the authors contributed to conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing and review and editing of the manuscript.

Funding

None.

Conflict of Interest

None declared.