THE BUCKET-HANDLE TEAR OF THE MENISCUS

A CLINICAL AND ARTHROGRAPHIC STUDY

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A retrospective series of 272 operatively proven bucket-handle tears of the meniscus has been studied to define the natural history of the tear and to assess the accuracy of arthrography as a diagnostic technique. A simple twist, or a sporting injury accounted for most tears in the 196 patients on whom information was sufficient to allow analysis. There was, however, either no known trauma or merely a history of crouching in 20 per cent of patients. These were distributed evenly throughout the age range. Most of the 272 patients presented either with a locked knee (43 per cent) or with a history of locking (37 per cent). Fifty per cent of those with a previous history of locking but who were clinically unlocked at the time of operation, had displaced bucket-handle tears, indicating that unlocking of the knee joint frequently represents anterior extension of the tear, rather than relocation of the displaced fragment of meniscus. Significant meniscal tears were identified in 77 per cent of the 187 arthogram reports that were studied. Most errors in diagnosis seemed to occur when the separated fragment was hidden in the intercondylar notch and the peripheral rim was misinterpreted as an intact meniscus.

Longitudinal tears of the meniscus account for 32 per cent of major meniscal lesions found at arthroscopy (Smillie 1967). The clinical term "bucket-handle tear" describes the tendency for the central fragment to displace into the intercondylar notch causing mechanical locking of the knee joint. Although large series of meniscectomies have been reported (Appel 1970; Smillie 1970; Noble and Erat 1980) none has presented a quantitative analysis of the behaviour and clinical features of the bucket-handle tear itself. This paper presents a detailed study of 272 operatively proven bucket-handle tears treated in Oxford between 1976 and 1981.

An increased awareness of the long-term deleterious effects of meniscectomy has led to routine double-contrast arthrographic assessment of most meniscal lesions before operation, including those with a history of mechanical locking. The arthrographic reports of 187 cases of bucket-handle tear have been analysed to establish the accuracy and value of this investigation.

The bucket-handle tear. A bucket-handle tear is an extended longitudinal tear at or near the periphery of the meniscus. It may run vertically, obliquely or in a complex way through the meniscal substance. It is widely held that the tear commences posteriorly (Smillie 1970; Sprague 1982) and then extends anteriorly allowing the bucket handle to prolapse into the intercondylar notch.

If the anterior extension of the tear is limited, then locking occurs (that is, a block to full extension of the knee joint). Unlocking of the joint is associated with relocation of the displaced portion, further extension of the tear anteriorly or rupture of the bucket handle.

Dandy (1982) has described the anatomical forms of the tear. These include (Fig. 1) the posterior horn tear, the incomplete tear which locks the joint; the complete tear which allows full extension; and rupture of the bucket handle itself. Multiple bucket-handle tears of the posterior horn of the medial meniscus have also been described (Smillie 1970) and peripheral separation can occur.

MATERIALS AND METHODS

A search of the Nuffield Orthopaedic Centre diagnostic index revealed that a total of 1200 meniscectomies were performed in Oxford from January 1976 to December 1981.

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1981. Two hundred and eighty-five (24 per cent) were undertaken for bucket-handle tears. Clinical records for 272 of these operatively proven bucket-handle tears formed the basis for this study. The age distribution for all bucket-handle tears is shown in Figure 2. The mean age was 29 years, but the range from 16 to 62 years demonstrates that this is not solely a lesion of the young individual. Only 35 tears (13 per cent) occurred in females and there was no difference in age distribution between the sexes. The medial meniscus was torn in 240 patients (88 per cent) and the lateral one in 32 patients (12 per cent).

![Age distribution of bucket-handle tears. Hatched areas denote female patients.](image)

**RESULTS**

**Mechanism of injury.** Information on 196 patients was sufficient to allow analysis and the results are presented in Figure 3. Forty per cent of these (80 tears) were sustained by a simple twist not associated with sport, and 36 per cent (72 tears) were sustained during sports of all kinds. Football, with 18 per cent (36 tears), made up the largest group among the sports injuries. In 10 per cent (20 tears), the injury was sustained during crouching and in a further 10 per cent there was no history of injury at all. Only 2 per cent (four tears) occurred during road traffic accidents.

Analysis of the mechanism of injury with respect to age (Fig. 3) demonstrated the expected rapid reduction in sporting injuries in the fifth decade. Of note, however, is that simple crouching or "no known injury" accounted for a similar number of tears at all ages.

**Locking of the knee.** A total of 118 patients (43 per cent of the 272 tears) presented for orthopaedic opinion with a locked knee; 101 (37 per cent of the 272 tears) with a history of true locking and 53 (20 per cent) with no history of locking at all. Table I shows the percentage of medial and lateral menisci in each group. Bucket-handle tears of the lateral meniscus presented with a locked knee in a similar proportion of cases to that of the medial meniscus.

**Table I. The incidence of locking for medial and lateral bucket-handle tears**

<table>
<thead>
<tr>
<th>Lateral meniscal tears</th>
<th>Medial meniscal tears</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Per cent</td>
</tr>
<tr>
<td>Locked knee</td>
<td>14</td>
</tr>
<tr>
<td>History of locked knee</td>
<td>6</td>
</tr>
<tr>
<td>No locking</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

An analysis of the timing of locking of the knee joint, in relation to the original injury, was performed. The results are shown in Figure 4. Of those knees exhibiting a history of locking, 41 per cent of knees locked at the initial injury and only half of these remained locked. Although 59 per cent did not lock at the initial injury most went on to lock spontaneously without further injury. This suggests that the tear occurred with the initial injury, and displacement of the bucket handle occurred later during normal activities.

**The position of the bucket handle at operation.** Surprisingly, many patients with full extension of the knee were found at operation to have a displaced bucket-handle tear (Table II). Unfortunately the position of the bucket handle was not recorded in some cases. Only those with a positive comment on the position have therefore been included. At least 50 per cent of those with a history of locking, but no clinical locking at the time of operation, had a displaced bucket-handle tear. This finding may reflect a failure on the part of the clinician to detect minor limitation of extension before operation, or it may indicate that unlocking of the knee joint reflects anterior extension of the tear, rather than relocation of the meniscus, more commonly than is supposed.

At least 32 per cent of those with no history of locking had displaced tears. This suggests an extensive tear with displacement at the initial injury.

**Associated injuries.** The anterior cruciate ligament was reported as damaged in 31 patients (11 per cent of the 272 studied) of which three tears were partial. In 26 patients there was a significant sporting injury that resulted in the meniscal tear.

**Arthrography and the bucket-handle tears.** Arthrography was performed before operation in 188 (69 per cent) of the patients studied. The examination was performed in 165 patients (88 per cent) to confirm clinical suspicion of a meniscal tear, in 11 patients (six per cent) because there was doubt about the side of a meniscal lesion, and in 12 patients (six per cent) because there was doubt.
Table II. Analysis of the position of the bucket handle at operation, with reference to locking of the knee joint

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Displaced (per cent)</th>
<th>Undisplaced (per cent)</th>
<th>Ruptured (per cent)</th>
<th>Not recorded (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locked at operation</td>
<td>118</td>
<td>85</td>
<td>—</td>
<td>—</td>
<td>15</td>
</tr>
<tr>
<td>History of locked knee</td>
<td>101</td>
<td>50</td>
<td>10</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>No history of locking</td>
<td>53</td>
<td>32</td>
<td>11</td>
<td>4</td>
<td>53</td>
</tr>
</tbody>
</table>

Mechanism | %  | Number |
-----------|-----|--------|
Simple twist | 40% | 80     |
Football     | 18% | 36     |
Other sport  | 18% | 36     |
Simple crouching | 10% | 20     |
No injury    | 10% | 20     |
Road traffic accident | 2%  | 4      |

Fig. 3
Age distribution of mechanism of meniscal injury. Hatched areas denote sporting injuries. Clear areas denote injuries due to simple twisting. Speckled areas indicate injuries due to crouching or no injury.

All knees with a history of locking

- 41% locked at initial injury
- 59% did not lock at initial injury
- 21% either unlocked spontaneously or were manipulated
- 20% remained locked until surgery
- 15% locked after a further injury
- 44% locked spontaneously later

Fig. 4
Analysis of timing of locking with respect to injury. All figures are expressed as a percentage of the number of knees with a history of locking. Information from 189 patients.
about the clinical diagnosis. The site of pain and local tenderness corresponded to the side of the bucket-handle tear in 86 per cent of cases. Arthrography was performed by one of two consultant radiologists or by a junior radiologist aided by a consultant. A double-contrast technique using air and ten millilitres of 60 per cent Urografin 290 (Schering Chemicals) was employed. The radiographic reports of 187 cases were studied and divided into the categories shown in Table III. Significant abnormalities noted were in the peripheral rim of the meniscus.

Anterior blunting of the meniscus, which may result from separation of a bucket-handle fragment, is extremely difficult to define in quantitative terms, because of variability in the normal anatomy of the meniscus. A gross example is shown in Figures 5 and 6, but interpretation of less obvious blunting, due to separation through an oblique tear, relies on the skill of the radiologist. In the absence of an associated tear in the posterior horn of the meniscus it may be difficult to infer the presence of a bucket-handle tear from anterior blunting alone.

Arthroscopy. Arthroscopy had been performed on only

Table III. Analysis of the arthrogram reports of 187 cases of bucket-handle tear

<table>
<thead>
<tr>
<th>Knee clinically not locked</th>
<th>Knee clinically locked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant meniscal pathology</td>
<td></td>
</tr>
<tr>
<td>Major tear</td>
<td>50</td>
</tr>
<tr>
<td>Bucket-handle tear</td>
<td>11</td>
</tr>
<tr>
<td>Posterior-horn tear</td>
<td>23</td>
</tr>
<tr>
<td>Blunt anterior-horn and posterior-horn tear</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>97 (86 per cent)</td>
</tr>
<tr>
<td>Failure to demonstrate significant meniscal pathology</td>
<td></td>
</tr>
<tr>
<td>Blunt anterior horn only</td>
<td>4</td>
</tr>
<tr>
<td>Equivocal or wrong</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>29 (14 per cent)</td>
</tr>
</tbody>
</table>

Meniscal lesions were identified in 145 cases (77 per cent) comprising major tears, bucket-handle tears, posterior-horn tears, and posterior-horn tears in association with blunting of the anterior meniscal horn. A further ten (five per cent) reported blunting of the anterior-horn alone, and 32 (17 per cent) reports were either equivocal or incorrect about the presence of a tear. If these last two groups are taken together, then the arthrogram was unhelpful in 42 cases (22 per cent). The examinations performed on locked knees have been analysed separately in Table III. Significant tears were demonstrated in 77 per cent of locked knees and in 86 per cent of those knees that were clinically not locked at the time of examination.

Further analysis of the 42 tears where the arthrogram failed to reveal a significant meniscal tear was undertaken (Table IV). For obvious reasons this study could only detect false negative reports. Few menisci were reported as normal (16 per cent). In the majority of patients, while supporting the clinical impression that the meniscus was abnormal, the arthrogram failed to define the severity of damage. Operation performed soon after the arthrogram revealed a displaced bucket-handle tear in at least 33 patients (the position of the fragment was not recorded in a further six cases). It seems that most of the inaccurate reports may have resulted from the displaced fragment being hidden in the intercondylar notch and the minor

Table IV. Analysis of the 42 tears where the arthrogram failed to reveal a significant meniscal tear

<table>
<thead>
<tr>
<th>Tears</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meniscus reported as normal</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Anterior blunting noted</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Possibility of tear mentioned</td>
<td>19</td>
<td>45</td>
</tr>
<tr>
<td>Minor tear noted</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Medial meniscal tears</td>
<td>34</td>
<td>81</td>
</tr>
<tr>
<td>Lateral meniscal tears</td>
<td>8</td>
<td>19</td>
</tr>
</tbody>
</table>

Figure 5 — Blunting of the anterior horn of the medial meniscus found at arthrography. Figure 6 — Normal anterior horn for comparison.
62 patients in this series. It was employed principally after an equivocal arthrograph or when there was doubt about the integrity of the opposite meniscus. Confirmation of a bucket-handle tear was obtained in all but one case that failed because of technical problems.

**DISCUSSION**

The bucket-handle tear was found to be uncommon in the lateral meniscus, comprising only 12 per cent of cases. When present, however, the tear appeared to cause mechanical problems in a similar proportion of cases as on the medial side. The observations that locking of the knee occurs less frequently with lateral meniscal lesions (Smillie 1970) probably reflects the relative infrequency of the bucket-handle tear on this side, rather than a difference in its behaviour. Tears of the degenerate meniscus commonly occur with minimal trauma. It is of interest, however, that 20 per cent of the bucket-handle tears, some in young individuals, were sustained either by simple crouching or without apparent injury. The absence of a history of trauma does not preclude a major longitudinal tear even in the young. Of those patients who gave a history of locking, 59 per cent did not lock at the original injury. However, the majority of these (73 per cent) went on to lock without further trauma, suggesting that the tear occurred at the outset and displacement followed during normal activities.

Although the data are incomplete, it is possible to make a comment on the incidence of a complete displaced bucket-handle tear without a history of locking. Of the 20 per cent of cases with no history of mechanical locking, including only those with a positive comment on the position of the bucket handle at operation, 64 per cent showed a displaced bucket-handle tear. This gives an overall incidence of 11 per cent for a displaced bucket-handle tear with no history of locking.

The mechanism of unlocking of the knee is clarified by the data presented. At least 50 per cent of those with previous locking but who were unlocked clinically at the time of operation, had displaced tears. Anterior extension of the tear, rather than relocation of the meniscus, is much more common than is supposed. Very few of these individuals underwent manipulation of the knee and it must therefore be inferred that this extension of the tear occurred spontaneously during single or repeated episodes of displacement. Persistent dislocation of a meniscal fragment has implications for the interpretation of arthrography. The deleterious effects that such a dislocation may have on the articular cartilage of the knee are not known.

The clinical diagnosis of meniscal pathology had been made before arthrography in most cases in this series. The arthrograph was performed to assess the severity of this damage.

The term “bucket-handle tear” is essentially a clinical description of the behaviour of the longitudinal tear. It is therefore not surprising that the term was used relatively infrequently by the radiologists. Most reports simply described the anatomy and extent of the longitudinal tear.

Although the meniscus was rarely reported as normal, most inaccuracies arose in assessing the extent of damage to the meniscus. It seems likely that an unrecognised displaced meniscal fragment was present in these cases and the peripheral rim was interpreted as an entire meniscus.

None of the series of arthrograms reported in the literature (Nicholas, Freiberger and Killoran 1970; De Haven and Collins 1975; Hirschowitz 1976; Gillies and Seligson 1979; Ireland, Trickey and Stoker 1980) concentrate on a single type of meniscal lesion and thus are not directly comparable with this report. Accuracy of detecting meniscal lesions in these series varied from 78 per cent by De Haven and Collins to 97.5 per cent by Nicholas et al. The 77 per cent accuracy quoted here refers only to false negative reports, in that the arthrogram failed to detect a significant tear.

The fact that displaced bucket-handle tears occurred commonly, even in the knee which was not clinically locked, should be borne in mind by all those who interpret arthrograms of patients with a history of mechanical locking.

We should like to thank Mr Nigel Webb for drawing the illustrations.

**REFERENCES**


