ABSTRACT

Purpose. To review the outcome of bone-peg grafting for osteochondritis dissecans (OCD) grade II lesions of the humeral capitellum.

Methods. Records of 10 male adolescent baseball players aged 10 to 15 (mean, 12.3) years who underwent bone-peg grafting for OCD grade II lesions of the humeral capitellum of the dominant arm were reviewed. The mean time from symptom onset to presentation was 11 (range, 1–36) months. The mean duration of conservative treatment was 5 (range, 1–25) months. The mean time from symptom onset to surgery was 17 (range, 3–39) months; it was >6 months in 6 patients. The mean size of the lesions was 13x14 mm. Patients were assessed for elbow pain, range of elbow and forearm motion, Timmerman-Andrews elbow score, return to sports activity level, and radiographic evidence of healing, osteoarthritic changes, and radial head hypertrophy.

Results. The mean follow-up period was 25 (range, 10–52) months. Postoperatively, elbow pain was absent in 6, mild in 2, and moderate in 2 patients. The mean range of elbow motion changed from 136° to 139° (p=0.80). The mean Timmerman-Andrews elbow score improved from 163 to 189 (p=0.014); it was excellent in 7, good in 2, and fair in one patient. The mean extent of lesion healing was 71% (range, 33–100%). Five patients achieved complete healing after a mean of 5.2 (range, 5–6) months and returned to sports at a competitive level. The other 5 achieved partial healing of 33 to 56% (mean, 41%) that occurred laterally but not medially. Two of them returned to sports at a competitive level: one changed the throwing side and another had radial head hypertrophy. The remaining 3 underwent arthroscopic debridement of the unhealed lesion at 5, 10, and 15 months. One patient developed secondary osteoarthritis and further underwent costal osteochondral autografting 10 months later. None of the 5 patients with partial healing versus 4 of the 5 patients with complete healing underwent surgery within 6 months of symptom onset. All 3 patients with a dot at the interface versus 2 of the 6 patients with a line at the interface between the fragment and the lesion on MRI had complete healing.

Conclusion. Bone-peg grafting is a viable option for OCD grade II lesions of the humeral capitellum when performed within 6 months of symptom onset and when the interface between the fragment and the lesion appears as a dot (rather than a line) on MRI.

Key words: baseball; bone transplantation; elbow; osteochondritis dissecans
INTRODUCTION

Early or stable osteochondritis dissecans (OCD) of the humeral capitellum in young athletes, especially baseball players and gymnasts, is usually managed conservatively, and results are generally good.1–3 When conservative treatment fails or lesions increase, surgical treatment is recommended and includes arthroscopic removal of the loose bodies,1,4 fixation with bone-peg grafts,1,5,6 closed-wedge osteotomy,7,8 and fixation with osteochondral plug grafts from the knee9–12 or rib.13,14 According to the International Cartilage Repair Society (ICRS) classification of OCD lesions,15 bone-peg grafting is indicated for OCD grade II or III lesions. Nonetheless, the optimal indications for bone-peg grafting remain controversial. This study reviewed the outcome of bone-peg grafting for OCD grade II lesions of the humeral capitellum.

MATERIALS AND METHODS

This study was carried out in accordance with the Declaration of Helsinki and approved by the institutional ethics committee. Records of 10 male adolescent baseball players aged 10 to 15 (mean, 12.3) years who underwent bone-peg grafting for OCD grade II lesions of the humeral capitellum of the dominant left (n=1) or right (n=9) arm between 2005 and 2011 were reviewed.

Symptoms included pain at throwing in all and limited range of motion in one. None had elbow catching. The mean time from symptom onset to presentation was 11 (range, 1–36) months. The mean duration of conservative treatment was 5 (range, 1–25) months. The mean time from symptom onset to surgery was 17 (range, 3–39) months; it was >6 months in 6 patients.

OCD lesions were classified on radiographs with the elbow in 45° flexion (anteroposterior tangential view).1,16 Patients with radiolucency were classified as grade I (n=1) and with non-displaced fragments as grade II (n=9); none had displaced fragments (grade III). The epiphyseal line in the humeral capitellum was open in 6 and closed in 4 patients. The lesions were located at the centre (n=4) or lateral (n=6) capitellum. The mean size of the lesions was 13x14 mm. The lesions were hyperintense on T2-weighted, fat-suppressed sagittal magnetic resonance imaging (MRI) and appeared as a dot in 3 patients and as a line in 6 patients (Fig. 1).17 The remaining patient did not undergo MRI due to claustrophobia. None had irregular contours or defects of the articular surface.

Under general anaesthesia, patients were evaluated arthroscopically; all the OCD lesions were confirmed to be grade II. An elongated skin incision was made distal to the olecranon through a posterolateral approach.9,18 The anconeus muscle insertion was retracted subperiosteally to the radial side, and the lateral osseous surface of the olecranon crest was explored. Corticocancellous bone-pegs were harvested at the posterior and lateral surface of the olecranon crest. The length of the bone-pegs ranged from 15 to 20 mm, and the diameter ranged from 2 to 3.5 mm. When the capitellar growth plate was open, the length of the bone-peg was modified so that it did not reach the growth plate. During insertion of the bone-peg, the head of the bone-peg was countersunk 1 to 2 mm below the surface of the articular cartilage (Fig. 2). Lesions were fixed with one (n=3), 2 (n=3), 3 (n=3), or 4 (n=1) bone-pegs in situ. Fixation with just one bone-peg at the lesion centre was deemed sufficient.

Postoperatively, the forearm was immobilised in a neutral position for 3 weeks, followed by range of motion exercises. Gentle resistance exercises were started at 3 months and progressed to full resistance at 4 months. Throwing activities was resumed at 3 months only if the patient had no elbow pain, normal range of elbow motion, and radiographic evidence of healing. Return to full sports activities was allowed at 6 months.

Patients were assessed for elbow pain, range of elbow and forearm motion, grip strength, Timmerman-Andrews elbow score,19 return to sports activities, and osteoarthrosis on postoperative X-rays. All patients returned to full sports activities after 6 months.
activity level, and radiographic evidence of healing, osteoarthritic changes, and radial head hypertrophy. Elbow pain was classified as no pain, mild (pain only after intense activity), or moderate/severe (pain after daily activities or even at rest). Timmerman-Andrews elbow score was classified as excellent (180–200), good (160–179), fair (120–159), or poor (<120). The return to sports activity level was classified as competitive, recreational, or substantial limitation. Lesion healing was classified as complete (100%) or partial (<100%); healing percentage was calculated as healing area diameter divided by the lesion diameter x100 (Fig. 3).

Pre- and post-operative elbow range of motion was compared using the paired t-test. A p value of <0.05 was considered statistically significant. Association between the extent of lesion healing and the time from symptom onset to surgery, location and size of the lesion, diameter and number of bone-pegs, openness of the capitellar physis, or MRI appearance was assessed.

RESULTS

The mean follow-up period was 25 (range, 10–52) months (Table 1). Postoperatively, elbow pain was absent in 6, mild in 2, and moderate in 2 patients (Table 2). The mean range of elbow motion changed from 136° to 139° (p=0.80); extension from 0° to -0.5° (p=0.91) and flexion from 136° to 139° (p=0.60). The mean Timmerman-Andrews elbow score improved from 163 (range, 115–170) to 189 (range, 150–200) [p=0.014]; it was excellent in 7, good in 2, and fair in one patient.

The mean extent of lesion healing was 71% (range,
### Table 1
Characteristics of 10 adolescent males with osteochondritis dissecans of the humeral capitellum

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Time from symptom onset to surgery (months)</th>
<th>Capitellar physis</th>
<th>Lesion appearance</th>
<th>Lesion location at capitellum</th>
<th>Lesion size (mm)</th>
<th>Bone-peg diameter (mm)</th>
<th>No. of bone-peg use</th>
<th>Follow-up (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>3</td>
<td>Open</td>
<td>Dot</td>
<td>Lateral</td>
<td>12x12</td>
<td>3.5</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>5</td>
<td>Open</td>
<td>Dot</td>
<td>Centre</td>
<td>14x18</td>
<td>3</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>5</td>
<td>Closed</td>
<td>Dot</td>
<td>Centre</td>
<td>13x17</td>
<td>3</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>6</td>
<td>Open</td>
<td>Line</td>
<td>Lateral</td>
<td>15x15</td>
<td>2</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>39</td>
<td>Closed</td>
<td>Line</td>
<td>Lateral</td>
<td>10x13</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>9</td>
<td>Open</td>
<td>Line</td>
<td>Lateral</td>
<td>13x13</td>
<td>2</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>29</td>
<td>Open</td>
<td>Line</td>
<td>Centre</td>
<td>13x13</td>
<td>2.5</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
<td>27</td>
<td>Open</td>
<td>Line</td>
<td>Lateral</td>
<td>12x12</td>
<td>3</td>
<td>1</td>
<td>52</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>37</td>
<td>Closed</td>
<td>Line</td>
<td>Centre</td>
<td>15x15</td>
<td>3</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>10</td>
<td>Closed</td>
<td>-</td>
<td>Lateral</td>
<td>11x13</td>
<td>3.5</td>
<td>3</td>
<td>34</td>
</tr>
</tbody>
</table>

### Table 2
Outcomes after bone-peg grafting for 10 adolescent males with osteochondritis dissecans of the humeral capitellum

<table>
<thead>
<tr>
<th>Patient</th>
<th>Postop elbow pain</th>
<th>Elbow range of motion (extension, flexion)</th>
<th>Preop</th>
<th>Postop</th>
<th>Preop</th>
<th>Postop</th>
<th>Lesion healing %</th>
<th>Return to sports Months Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mild</td>
<td>-30º, 110º</td>
<td>0º, 140º</td>
<td>115</td>
<td>200</td>
<td>100</td>
<td>5</td>
<td>Competitive</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>-5º, 140º</td>
<td>0º, 135º</td>
<td>165</td>
<td>200</td>
<td>100</td>
<td>6</td>
<td>Competitive</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>5º, 135º</td>
<td>0º, 140º</td>
<td>170</td>
<td>200</td>
<td>100</td>
<td>7</td>
<td>Competitive</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>0º, 130º</td>
<td>0º, 150º</td>
<td>170</td>
<td>200</td>
<td>100</td>
<td>7</td>
<td>Competitive</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>-5º, 145º</td>
<td>0º, 140º</td>
<td>165</td>
<td>200</td>
<td>100</td>
<td>6</td>
<td>Competitive</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>0º, 140º</td>
<td>0º, 140º</td>
<td>170</td>
<td>200</td>
<td>46</td>
<td>6</td>
<td>Competitive</td>
</tr>
<tr>
<td>7</td>
<td>No</td>
<td>0º, 140º</td>
<td>0º, 145º</td>
<td>170</td>
<td>200</td>
<td>33</td>
<td>4</td>
<td>Competitive</td>
</tr>
<tr>
<td>8</td>
<td>Moderate</td>
<td>20º, 140º</td>
<td>0º, 145º</td>
<td>160</td>
<td>170</td>
<td>33</td>
<td>-</td>
<td>Substantial limitation</td>
</tr>
<tr>
<td>9</td>
<td>Moderate</td>
<td>15º, 150º</td>
<td>0º, 140º</td>
<td>170</td>
<td>170</td>
<td>38</td>
<td>-</td>
<td>Substantial limitation</td>
</tr>
<tr>
<td>10</td>
<td>Mild</td>
<td>0º, 130º</td>
<td>-5º, 110º</td>
<td>170</td>
<td>150</td>
<td>56</td>
<td>-</td>
<td>Substantial limitation</td>
</tr>
</tbody>
</table>

33–100%). Five patients achieved complete healing (Fig. 4) after a mean of 5.2 (range, 5–6) months and returned to sports at a competitive level. The other 5 achieved partial healing of 33 to 56% (mean, 41%) that occurred laterally but not medially. Two of them returned to sports at a competitive level: one changed the throwing side and another had radial head hypertrophy. The remaining 3 underwent arthroscopic debridement of the unhealed lesion at 5, 10, and 15 months; 2 of them eventually had no elbow pain or restricted range of motion, and had a Timmerman-Andrews elbow score of 200. The third patient had loose bodies in the ulnohumeral joint, mild elbow pain, restricted range of elbow motion (extension: -35º, flexion: 100º) and progressed to secondary osteoarthritis. He further underwent costal osteochondral autografting 10 months later. At 34 months, he had no elbow pain, a range of elbow motion of 105º (extension: -5º, flexion: 110º),

![Figure 4](image_url) A 10-year-old boy with an osteochondritis dissecans grade II lesion: (a) preoperative radiograph with the elbow in 45º flexion showing non-displaced fragments. (b) At 27 months, radiograph showing complete healing of the capitellum, no visible osteophytes, and no progressive secondary osteoarthritic change.
and a Timmerman-Andrews elbow score of 150. He changed his sport to tennis. His radiographs showed central subluxation of the radial head and progressive osteoarthritic changes (Fig. 5).

None of the 5 patients with partial healing versus 4 of the 5 patients with complete healing underwent surgery within 6 months of symptom onset. All 3 patients with a dot at the interface versus 2 of the 6 patients with a line at the interface between the fragment and the lesion on MRI had complete healing. Nonetheless, lesion healing was not associated with openness of the capitellar epiphysis, location of the OCD lesion, or the diameter or number of bone-peg.

**DISCUSSION**

In a study of bone-peg grafting for osteochondral fragments, 15 of 16 patients achieved bony union within a mean of 6.5 months, and one patient with osteoarthritis did not heal.4 Four patients with a (Minami classification) grade I lesion healed within a mean of 4.7 months; 10 patients with a grade II lesion healed within a mean of 7.1 months; and 6 patients with grade III lesions healed within a mean of 6.2 months.8 In another study of bone-peg grafting and/or insertion of a resorbable pin for unstable OCD lesions but attached to the bony bed of the capitellum, 6 of 7 patients achieved bony union and one failed.5

In studies of osteochondral plug grafting for OCD grade III and IV lesions, the mean Timmerman-Andrews score has been reported to improve significantly: from 150 to 180 with 77% of patients able to resume their former level of sport,10 from 131 to 191 with 90% of patients able to resume their former level of sport,11 and from 130 to 190 with 91% of patients able to resume their competitive level after a mean of 6.9 months.12 In our study, the score improved from 163 to 189 with 70% of patients able to resume sport at a competitive level. Therefore, the results of bone-peg grafting for OCD grade II lesions are inferior to those of osteochondral plug grafting for grade III and IV lesions. This may indicate that bone-peg grafting is less effective for healing at the medial site of the cartilage-rich lesion.

Patients with a line at the interface between the fragment and the lesion on MRI should have been treated with osteochondral plug grafting even though...
the lesions were confirmed arthroscopically as grade II. Although the indication for bone-peg grafting is OCD grade II or III lesions,\(^1\) results were more favourable when surgery was performed within 6 months of symptom onset, or when the interface between the fragment and the lesion appears as a dot (rather than a line) on MRI. Patients with delayed treatment (>1 year) achieve inferior results; early treatment is recommended.\(^6\) Bone-peg grafting prevents the development of osteoarthritis more effectively than conservative treatment or removal of loose bodies alone.\(^6\)

**CONCLUSION**

Bone-peg grafting is a viable option for OCD grade II lesions of the humeral capitellum when performed within 6 months of symptom onset and when the interface between the fragment and the lesion appears as a dot (rather than a line) on MRI.

**DISCLOSURE**

No conflicts of interest were declared by the authors.

**REFERENCES**