ABSTRACT

Purpose. To review the outcome of 9 adolescents treated with 2 to 3 cannulated cancellous screws for type-1 capitellum fractures.

Methods. Records of 8 boys and one girl aged 12 to 14 (mean, 14) years with type-1 capitellum fractures were reviewed. The mechanism of injury was a fall on the flexed elbow. No patient had associated injuries or neurovascular compromise. In 2 patients, the fracture was minimally displaced and treated with a cast. The remaining 7 patients with displaced fractures underwent open reduction and internal fixation using 4.0-mm cannulated partially threaded cancellous screws inserted in a posterior-to-anterior direction. In one patient, a Kirschner wire was added to fix a small comminuted fragment. Elbow pain, range of motion, stability, and function were evaluated using the Mayo Elbow Performance Index.

Results. The mean follow-up period was 7 (range, 2–18) months. The mean Mayo Elbow Performance Index score was 100, indicating excellent outcome. No patient developed avascular necrosis or heterotrophic ossification. All patients achieved anatomic bone union. All implants were removed after a mean of 4.7 (range, 2–7) months.

Conclusion. The fixation of type-1 capitellum fractures with 2 to 3 cannulated cancellous screws inserted posteroanteriorly achieved excellent functional outcome.

Key words: adolescent; elbow; fracture fixation, internal

INTRODUCTION

Capitellum fractures are rare, particularly in children. Only one such case in a series of 2000 elbow fractures in children has been reported. A lateral condylar physeal fracture with displacement of the capitellum is more likely to occur in children. If a capitellum fracture is left untreated, functional disability may result owing to limited elbow range of motion. Capitellum fractures are classified into 3 types. Type 1 (Han Steinhall type) is a complete osteochondral capitellum fracture. Type 2 (Kocher-
Lorenz type) is a superficial osteochondral fracture affecting nearly pure articular cartilage and little or no subchondral bone. Type 3 is a comminuted fracture. In addition, type 4 is a coronal shear fracture involving the capitellum and a portion of the trochlea.7 Treatments include closed reduction, open reduction and internal fixation, and excision of the fractured fragment.8–13 Internal fixation devices consist of Kirschner wires, Herbert screw, cannulated cancellous screws, and single 3.5 mm lag screw. A horizontal mattress cross-stitch suture technique has also been used for a type-2 capitellum fracture.10 We reviewed outcome of 9 adolescents treated with 2 to 3 cannulated cancellous screws for type-1 capitellum fractures.

MATERIALS AND METHODS

Records of 8 boys and one girl aged 12 to 14 (mean, 14) years who underwent cannulated cancellous screw fixation for type-1 capitellum fractures between 2007 and 2009 were reviewed. The mechanism of injury was a fall on the flexed elbow. No patient had associated injuries or neurovascular compromise. In 2 patients, the fracture was minimally displaced and treated with an above-elbow backslab for one week and then a full fibreglass cast for one month. Upon radiographic bone union with no bony tenderness, physiotherapy with gentle range of motion exercises was started.

The remaining 7 patients with superiorly or anteriorly displaced fractures underwent open reduction and internal fixation using 4.0-mm cannulated partially threaded cancellous screws. A posterolateral skin incision was made. The lateral collateral ligament was preserved. The fracture was accurately reduced and fixed with 2 to 3 screws inserted in a posterior-to-anterior direction. With the aid of fluoroscopy, care was taken not to violate the joint surface. In one patient, a Kirschner wire was added to fix a small comminuted fragment.

Postoperatively, a long posterior above-elbow backslab was applied for 7 to 14 days and then a removable elbow splint until bone union. Range of motion exercises were then started. Elbow pain, range of motion, stability, and function were evaluated using the Mayo Elbow Performance Index.14

RESULTS

The mean follow-up period was 7 (range, 2–18) months. The mean Mayo Elbow Performance Index score was 100, indicating excellent outcome (Table). No patient developed avascular necrosis or heterotrophic ossification. All patients and their parents were satisfied with the outcome, except for one parent who concerned about keloid formation over the incision scar. All patients achieved anatomic bone union (Fig.). All implants were removed after a mean of 4.7 (range, 2–7) months.

DISCUSSION

The most common injury mechanism for capitellum fractures is a fall on an outstretched hand, with the radius imparting a shearing force onto the capitellum.7 As the capitellum is situated over the anterior portion of the lateral condyle, the fractured fragment is often displaced superiorly and anteriorly.

<table>
<thead>
<tr>
<th>Sex/age (years)</th>
<th>Mechanism of injury</th>
<th>Fracture type/side</th>
<th>Management*</th>
<th>Implant removal (months)</th>
<th>Mayo Elbow Performance Index</th>
<th>Complication</th>
<th>Elbow range of motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/13</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/lef</td>
<td>ORIF with 3 screws</td>
<td>4</td>
<td>100</td>
<td>-</td>
<td>0°–150°</td>
</tr>
<tr>
<td>M/13</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/lef</td>
<td>ORIF with 2 screws</td>
<td>6</td>
<td>100</td>
<td>-</td>
<td>0°–150°</td>
</tr>
<tr>
<td>M/14</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/right</td>
<td>ORIF with 3 screws</td>
<td>7</td>
<td>100</td>
<td>-</td>
<td>0°–150°</td>
</tr>
<tr>
<td>M/13</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/right</td>
<td>ORIF with 2 screws</td>
<td>5</td>
<td>100</td>
<td>-</td>
<td>0°–150°</td>
</tr>
<tr>
<td>M/12</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/right</td>
<td>ORIF with 3 screws + 1 Kirschner wire</td>
<td>6</td>
<td>100</td>
<td>-</td>
<td>5°–150°</td>
</tr>
<tr>
<td>M/13</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/right</td>
<td>ORIF with 3 screws</td>
<td>3</td>
<td>100</td>
<td>Keloid</td>
<td>5°–150°</td>
</tr>
<tr>
<td>M/14</td>
<td>Fall on flexed elbow</td>
<td>Type-1 displaced/right</td>
<td>ORIF with 3 screws</td>
<td>2</td>
<td>100</td>
<td>-</td>
<td>0°–150°</td>
</tr>
<tr>
<td>M/13</td>
<td>Fall on flexed elbow</td>
<td>Type-1 undisplaced/lef</td>
<td>Casting for 1 month</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>0°–150°</td>
</tr>
<tr>
<td>F/12</td>
<td>Fall on flexed elbow</td>
<td>Type-1 undisplaced/lef</td>
<td>Casting for 1 month</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>0°–140°</td>
</tr>
</tbody>
</table>

* ORIF denotes open reduction and internal fixation*
In our series, all patients fell directly on the flexed elbow.

Capitellum fractures are uncommon in adults and rare in adolescents. In our series, all 9 capitellum fractures were initially diagnosed by radiologists as distal humerus fractures. Computed tomography and magnetic resonance imaging are more accurate diagnostic tools. Nonetheless, anteroposterior and lateral (and sometimes additional oblique) radiographs are usually sufficient to make a diagnosis and more cost-effective.

There is no consensus on treatment methods, which include closed reduction and immobilisation in a cast, excision of the fractured fragment, and open reduction and internal fixation using various implants. In a 12-year-old patient with a type-2 capitellum fracture, fixation with Kirschner wires or screws was difficult as the fragments were very small. A horizontal mattress suture cross-stitch technique was used to provide compression across the fracture site and achieve stability. This enabled immediate postoperative motion, obviated the need for implant removal, and facilitated assessment of healing by magnetic resonance imaging. Timely removal of implants is important for adolescents with growing bones.

In 5 type-1 capitellum fractures treated with internal fixation using Kirschner wires (n=3), Herbert
screws (n=1), or cannulated screws (n=1),\textsuperscript{8} one of the patients underwent revision surgery to remove an exostosis block to flexion, which was probably secondary to inaccurate reduction. Internal fixation using a lag screw achieves satisfactory outcome, but objective evaluation is lacking.\textsuperscript{15} Internal fixation using a single 3.5-mm lag screw inserted posteroanteriorly without penetrating the joint surface also achieves good outcome.\textsuperscript{9} Fixation with cancellous lag screws is more stable when inserted posteroanteriorly rather than anteroposteriorly (p=0.007).\textsuperscript{16} Headless screws (Actrac compression screw) provide more fixation stability than cancellous lag screws do.\textsuperscript{16} In our series, fixation with 2 to 3 cannulated partially threaded cancellous screws resulted in no implant prominence, failure, or iatrogenic fracture, while also conferring rotational stability. A compression force across the fracture site enabled almost immediate postoperative mobilisation. The backslab was used to reduce pain rather than protect the fixation.

The fixation method used should depend on the fracture type, the skill level of the surgeon, and the cost-effectiveness of the implant. We advocate using at least 2 standard partially threaded cancellous screws. Further studies to compare outcomes following single versus multiple lag screw fixation are needed.

For evaluation of elbow function, no single scoring system is reliable, valid, sensitive to clinically relevant changes, and able to take account the perspective of both patients and physicians.\textsuperscript{17} Among the 5 scoring systems (Mayo Elbow Performance Index, Broberg and Morrey system, Ewald system, The Hospital for Special Surgery system, and Pritchard system), the Mayo Elbow Performance Index and the Ewald system appear to be the most discriminating.\textsuperscript{18}

REFERENCES