PRONATOR QUADRATUS PECICLED BONE GRAFT FOR OLD SCAPHOID FRACTURES

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Delayed union or non-union of the scaphoid was treated by a bone graft on a pronator quadratus pedicle in eight cases. This produced earlier union than the Russe procedure. The procedure is simple and is recommended for old-united scaphoid fractures.

Failure to diagnose a fracture of the carpal scaphoid or its inadequate conservative treatment may result in delayed union or non-union. Treatment is then difficult and osteoarthritic change may follow in an untreated case. We have modified a simple grafting technique (Braun 1983; Chacha 1984); this consistently achieves early bony union.

METHOD AND PATIENTS

Technique of operation. A volar zig-zag incision is made over the scaphoid tuberosity and the distal radius to expose the site of non-union of the scaphoid. The radioscapohapitate ligament complex is divided, but retained for later repair to the muscle pedicle. The sclerotic bone ends are then excised and freshened with a powered burr to form an oval cavity 10 to 20 mm long and parallel to the axis of the scaphoid. On the distal radius, the pronator quadratus is identified and a block of bone graft about 15 to 20 mm long is outlined at its distal insertion close to the abductor pollicis longus tendon. Holes are made along the margin of the graft with Kirschner wire to facilitate separation with a fine osteotome. Care is taken that the pronator quadratus is not detached from the harvested bone graft, and the muscle is dissected towards the ulna to secure a pedicle 20 mm thick. The anterior interosseous vessels need not be identified. If the muscle is too tight to allow easy transfer of the pedicled bone, the ulnar origin of the pronator quadratus is dissected subperiosteally from the ulna through an additional incision over the distal ulna (Fig. 1).

The proximal and distal scaphoid segments are aligned carefully as a traction force is applied to the thumb. This manoeuvre corrects any intercalated segment instability and allows the grafted bone to be inserted snugly into the cavity in the scaphoid. The proximal and distal scaphoid segments and the graft are then firmly fixed with two 1.2 mm Kirschner wires.
introduced at the scaphoid tuberosity (Figs 1, 2 and 3). The radiocarpal joint is not crossed by a Kirschner wire.

The skin is closed and a long arm cast with thumb spica is applied for one month, followed by a short cast for a further month. At two months, union is evaluated from radiographs (Fig. 4), and in case of doubt tomograms may be useful (Fig. 5). The wrist is braced in a functional position for another one to two months and active exercises are then started. When stable bony union is certain, the Kirschner wires are removed, usually about four months after operation.

**Patients.** Between 1985 and 1987 a pronator quadratus pedicled bone graft was performed for eight cases of old ununited scaphoid fracture. All patients were men with right sided fractures and their age at operation ranged from 16 to 31 years (average 24.1 years). Follow-up was from five to 26 months (average 15.4 months). The original fractures were sustained in motorcycle accidents by three patients and were sports injuries in the other five. Surgery was indicated from four months to 16 years after injury (average 59 months) because of complaints of pain on exertion. The fracture had been missed at the initial examination in six patients, while, in two, cast immobilisation for one month and three months respectively had failed to result in union. The fracture was in the distal third in one case, the middle third in six, and the proximal third in one; it was transverse in six cases and oblique in two. There were no pre-operative osteoarthritic changes, but in one case there were sclerotic changes in the proximal part of both the scaphoid and the lunate.

**RESULTS**

At operation, four cases showed fibrous non-union and four had sclerotic pseudarthroses (Table I). The length of the bone graft ranged from 7 to 20 mm. All eight cases showed radiographic union after an average of 8.5 weeks (range 7 to 10 weeks), and the two cases which showed dorsal intercalated segment instability pre-operatively had normal alignment after operation. The average range of movement of the wrist improved after operation. Taken as a percentage of the normal range, dorsiflexion increased from 69 to 80%, palmar flexion changed from 77 to 73%, radial deviation from 45 to 71%, and ulnar deviation from 69 to 82%. Grip strength improved from 86 to 90% of normal. All the patients

Case 7. Figure 2 – Pre-operative radiograph showing non-union of the scaphoid. Figure 3 – The grafted bone on its pedicle snugly fills the excavated defect and is held with two Kirschner wires. Figures 4 and 5 – Bony union is seen at seven weeks after operation and is confirmed by tomography.
Table I. Details of eight cases of pedicled bone graft for scaphoid non-union. All patients were men and all had a right-sided injury.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (years)</th>
<th>Interval between injury and operation (months)</th>
<th>Type of non-union</th>
<th>Time to bony union (weeks)</th>
<th>Follow-up (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
<td>6</td>
<td>Fibrous</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>11</td>
<td>Sclerotic</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>3*</td>
<td>24</td>
<td>84</td>
<td>Fibrous with one loose body</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>120</td>
<td>Sclerotic</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>10</td>
<td>Fibrous</td>
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<td>14</td>
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<tr>
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<tr>
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<td>22</td>
<td>40</td>
<td>Sclerotic</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>196</td>
<td>Sclerotic with loose bodies</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

* showed dorsal intercalated segment instability before operation.

have been able to return to their former activities with no pain.

DISCUSSION

Old ununited scaphoid fractures may be treated by cast immobilisation, pulsed electromagnetic fields, Russe grafting with donor bone or by internal fixation with or without bone graft. Similar results are claimed for all these methods, but when non-union is established, bone grafting is often advocated to facilitate healing and enable correction of any carpal malalignment. This technique usually involves a prolonged period of immobilisation; Russe (1960) reported 80 to 90% bony union after an average period of immobilisation after operation of 4.6 months. Rigid internal fixation such as a Herbert screw (1984) may be desirable to reduce immobilisation but its use requires technical skill.

Fixation of the bone graft with two Kirschner wires is stable and can easily be adjusted, while the viable, vascularised nature of the graft facilitates healing in relation to the poor blood supply of the proximal scaphoid and occasional avascular necrosis. Our modification of the pronator quadratus pedicled bone graft technique is easy and produces consistently good results, while needing no special equipment.

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REFERENCES


