Advanced Wrist Arthritis due to Scaphoid Non-union

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Abstract

Seven patients with advanced osteoarthritis due to long-standing scaphoid non-union were treated by distal scaphoid resection arthroplasty. All were men and average age 38 years. Mean interval from injury to operation was 7.7 years. Five patients were classified as SLAC stage II and two as stage III. After resection of the distal fragment, excellent results were found in two, good in three, fair and poor in each one according to Cooney’s scoring system. The mean radiolunate angle changed from –13.6° to -25.7° and the mean carpal height ratio changed from 0.49±0.03 to 0.44±0.04.
Introduction

Post traumatic osteoarthritis associated with long standing scaphoid nonunion remains a challenging problem to hand surgeons, when bone graft and internal fixation is planned because it is usually related to secondary dorsal intercalated segmental instability (DISI) and poor bone quality.

There have been many salvage procedures for Post traumatic osteoarthritis associated with long standing scaphoid non-union: limited intercarpal arthrodesis [1,7,14], proximal row carpectomy [1,12], and wrist fusion. Resection of the distal scaphoid has been proposed as a surgical alternative in early osteoarthritis [6,9,11]. The purpose of this paper is to present medium term results of distal scaphoid resection arthroplasty for treatment of advanced osteoarthritis of scapholunate advanced collapse (SLAC) stage II and III due to longstanding scaphoid nonunion.

Materials and Methods

Between January 1998 and May 2000, we reviewed seven patients who were treated with distal scaphoid resection arthroplasty for radioscaphoid arthritis due to long-standing scaphoid non-union. All patients were men with average age 38 (32-50) years. The dominant wrist was injured in six patients. Five non-unions were located in the waist, one in distal pole and one in proximal pole. The interval from injury to operation was average of 7.7 (4-10) years. There was no worker’s compensation (Table 1).

The arthritic changes associated with scaphoid nonunion was staged according to the scaphoid lunate advanced collapse (SLAC) arthritis [4,15]. Five patients were classified as stage II and two as stage III.
Table 1.

Summary of cases.

<table>
<thead>
<tr>
<th>Age/</th>
<th>Side/</th>
<th>Fracture site</th>
<th>Initial treatment</th>
<th>Interval*</th>
<th>SLAC++ stage</th>
<th>Arthritis other than RS</th>
<th>Avascular necrosis</th>
<th>Cystic change</th>
<th>F.U (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/32</td>
<td>R/D</td>
<td>Waist</td>
<td>Cast</td>
<td>10</td>
<td>II</td>
<td>scaphotrapezoid</td>
<td>DF</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>M/50</td>
<td>R/D</td>
<td>Waist</td>
<td>Neglected</td>
<td>4</td>
<td>III</td>
<td>scaphotrapezoid</td>
<td>DF</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>M/39</td>
<td>L/ND</td>
<td>Waist</td>
<td>Neglected</td>
<td>7</td>
<td>III</td>
<td></td>
<td>DF+Capitate</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>M/38</td>
<td>R/D</td>
<td>Proximal</td>
<td>Cast and BG</td>
<td>5</td>
<td>II</td>
<td>scaphotrapezoid</td>
<td>+</td>
<td>DF</td>
<td></td>
</tr>
<tr>
<td>M/36</td>
<td>R/D</td>
<td>Distal</td>
<td>Cast</td>
<td>10</td>
<td>II</td>
<td></td>
<td>+</td>
<td>DF</td>
<td></td>
</tr>
<tr>
<td>M/35</td>
<td>R/D</td>
<td>Waist</td>
<td>Neglected</td>
<td>10</td>
<td>II</td>
<td></td>
<td>+</td>
<td>DF</td>
<td></td>
</tr>
<tr>
<td>M/33</td>
<td>R/D</td>
<td>Waist</td>
<td>Neglected</td>
<td>10</td>
<td>+</td>
<td></td>
<td>+</td>
<td>DF</td>
<td></td>
</tr>
</tbody>
</table>

(M; male, R; right, L; left, D; dominant, ND; non-dominant, Mid; middle, Prox; proximal, Dist; distal, BG; bone graft, Interval*: Interval from injury to operation, SLAC++: The arthritic changes associated with scaphoid nonunion was staged according to the scaphoid lunate advanced collapse (SLAC) by Watson. RS†; radioscaphoid, DF; distal fragment, F.U; follow up)

Operative technique

This open procedure was originally described by Malerich et al [6] and was modified. Volar skin incision is made starting from the scaphoid tuberosity along with flexor carpi radialis for about 4 cm. Care is taken not to damage radial artery and branch of radial nerve. Surgical exposure is extended distally from the scaphotrapezoidtrapezium (STT) joint and proximally to the scapholunate joint. The capsule is incised longitudinally and reflected by sharp dissection from the STT joint. Nonunion site of the scaphoid can be identified just ulnar to the flexor carpiradialis (FCR), aided by image intensifier. Subperiosteal dissection is carried out to preserve the dorsal intercarpal ligament during the operation. After exposure, the distal part of scaphoid is excised in pieces or en bloc, dissecting close to the bone to prevent damage to the FCR tendon which is located close to the distal scaphoid. It should be inspected that the whole distal fragment of scaphoid bone is removed with osteophyte on the proximal and lunate. It should be also checked that there is no residual impingement throughout entire range of motion. The empty space created is left unfilled. The procedure is completed by deep soft tissue closure with absorbable suture and skin suture. The thumb is immobilized in thumb spica splint in functional abduction and opposition state for 7 days. Then the patient is allowed to begin active range of exercise without protection.
All patients were reassessed clinically and radiologically after mean follow up of 35 (25-43) months. Clinical results were evaluated on the basis of Cooney’s Clinical Scoring System [2].

The radiological assessment consisted of a standard four view scaphoid series in position of shoulder abduction 90°, elbow flexion 90° and wrist in neutral flexion and deviation and thin section CT scan. The measurements were carried out by independent observers [IHJ, CWO] and the preoperative and postoperative carpal height ratio and radiolunate angle were measured. Radiocarpal and intercarpal arthrosis was recorded. The presence of avascular necrosis as judged by slightly increased bone density on plain radiographs was recorded. Statistical analysis between preoperative and postoperative data was done with Wilcoxon signed rank test (P =0.05).

Results (Table 2)

Cooney’s wrist score, the average clinical score improved from 55.7 preoperatively to 78.6 postoperatively. At final evaluation, excellent results were found in two wrists, good results in three. One was rated as fair and one as poor.

At the last follow up examination, pain was reported as follows: severe in none, mild occasional in four, moderate, tolerable in one, and no pain in two. The mean pain score changed from 10.7 preoperatively to 20.7 postoperatively.

All patients went back to their former activities and job at an average of four weeks. Two patients changed to lighter work.

Wrist motion improved in flexion – extension from average of 81.4° (range, 30 to 120°) before surgery to average of 108.6° (range, 75 to 130°) after surgery. Radial-ulnar deviation improved from 30° (range, 0 to 45°) to 45° (range, 0 to 60°).

Grip strength improved in all from average 35.3 kgf till 44.7 kgf.
All patients had significant erosion between the distal part of scaphoid and the radial styloid. Typical radiographic changes were present, including radial styloid pointing, narrowing of the joint space, subchondral condensation of bone and osteophyte formation. Removal of the distal part of the scaphoid resulted in a change of the overall carpal alignment. The mean carpal height ratio changed from 0.49±0.03 before surgery till 0.44±0.04 after the surgery (p= 0.05). The mean radiolunate angle was −13.6°±6.3 preoperatively and -25.7°±12.1 at latest follow up.

There were no complications.

**Table 2**

**Summary of the results**

<table>
<thead>
<tr>
<th>Case</th>
<th>Pain</th>
<th>Range of motion</th>
<th>Grip strength (affected/normal)</th>
<th>CHR†</th>
<th>RLA‡</th>
<th>Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preop</td>
<td>Postop</td>
<td>Preop Postop</td>
<td>Preop</td>
<td>Postop</td>
<td>Preop Postop Preop Postop Preop Postop Preop Postop Preop Postop</td>
</tr>
<tr>
<td>1</td>
<td>Moderate</td>
<td>No</td>
<td>100/130</td>
<td>50/75</td>
<td>53/70</td>
<td>0.45</td>
</tr>
<tr>
<td>2</td>
<td>Severe</td>
<td>Moderate</td>
<td>30/75</td>
<td>6/55</td>
<td>15/45</td>
<td>0.46</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>Mild</td>
<td>60/95</td>
<td>45/55</td>
<td>55/60</td>
<td>0.46</td>
</tr>
<tr>
<td>4</td>
<td>Severe</td>
<td>Moderate</td>
<td>75/120</td>
<td>30/50</td>
<td>40/50</td>
<td>0.51</td>
</tr>
<tr>
<td>5</td>
<td>Moderate</td>
<td>Mild</td>
<td>100/120</td>
<td>46/60</td>
<td>55/60</td>
<td>0.51</td>
</tr>
<tr>
<td>6</td>
<td>Moderate</td>
<td>No</td>
<td>105/120</td>
<td>30/55</td>
<td>50/60</td>
<td>0.51</td>
</tr>
<tr>
<td>7</td>
<td>Moderate</td>
<td>Mild</td>
<td>100/110</td>
<td>35/65</td>
<td>45/65</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Mean ±SD 81.4±28.1 108.6±18.4 35.3±15.9 44.7±14.2 0.49±0.0 0.44±0.0 -13.6±6.3 -25.7±12.0 55.7±22.0 80.00±12.9

(No; No pain, Mild; Mild occasional, Moderate; Moderate, tolerable, Severe; Severe to intolerable, CHR†: carpal height ratio, RLA‡: radiolunate angle, * Cooney’s Clinical Scoring Chart. Excellent, 90-100, good, 80-90, fair, 65-80, poor less than 65)

**Case Presentation**

A 38 year old farmer who sustained scaphoid fracture 7 years ago, the patient denied the cast immobilization at that time. The patient complained aggravating wrist pain for 7 months when lifting and heavy things and squeezing something. Conservative treatments of nonsteroid antiinflammatory medications and physiotherapy did not relieve wrist pain significantly. Plain radiographs showed arthritic changes at radiosaphoid and scaphocapitate joint with hypoplastic proximal fragment (SLAC II) (Figure 1). Distal scaphoid fragment was excised through volar approach and the radial side articular cartilage of distal fragment was denuded (Figure 2). Postoperative radiographs at 35 months
after distal scaphoid resection arthroplasty, clinically pain has improved from severe to mild although DISI deformity and carpal collapse progressed; radiolunate angle from $-10^\circ$ to $-25^\circ$ and carpal height ratio from 0.51 to 0.5 (Figure 3).

Fig. 1 38 year old farmer with 7 year old scaphoid fracture, complained of pain on loading and motion. Initial plain radiographs showed arthritic changes at radioscapoid and scaphocapitate joint. Cystic changes in the distal fragment with relatively hypoplastic proximal fragment. Note sparing of the joint space between the radius and proximal fragment of the scaphoid.

Fig. 2 Intraoperative photograph shows arthritic distal fragment especially radial side (box) excised through volar approach.

Fig. 3 30 months after distal scaphoid resection arthroplasty, although clinical symptom has improved from severe to mild, DISI deformity and carpal collapse progressed; radiolunate angle from -10 to -25 and carpal height ratio from 0.51 to 0.5.
Discussion

Although much has been written regarding the treatment for scaphoid nonunion, a number of cases fail to get sound healing of the nonunion and require a salvage or reconstructive surgery. Sometimes patients with scaphoid nonunion are late in seeking consultation until carpal deformity and degenerative changes are already evident, which provide a challenge to the treating surgeon. Four patients in this series did not have prior treatment and three patients had prior formal treatment, which failed to unite the scaphoid.

Several authors [5,8,13] observed that degenerative changes develop in the articulation between the distal scaphoid fragment and radius and that the lunate are spared from degenerative changes. Within the first decade after the fracture, they commonly found changes in the quality of bone, including cystic lesions at the site of the scaphoid nonunion. During the second decade, radioscaphoid degenerative changes were evident, followed in the third decade by progressive pancarpal arthritis. The pattern of arthritis in scaphoid non-union is similar to scapholunate advance collapse (SLAC) wrist resulting from rotatory subluxation of the distal scaphoid fragment [15,16]. According to the study by Vender for non-unions of 4 years duration, 75% of patients had radioscaphoid changes, and for those of 9 years duration, 60% of the patients had midcarpal changes [13]. In this series, the average interval from injury to development of symptoms was 7.7 years. All patients presented arthritic change between the distal scaphoid fragment and radius. Cystic changes were present at distal fragment in all seven patients preoperatively and definite sclerosis of the proximal fragment was found in two patients, however during
the operation, all distal fragments were arthritic especially radial side when excised [Figure 2].

While it is known that the radio-proximal scaphoid fragment joint and the radiolunate joint were consistently spared from degenerative changes [15], we found that degenerative changes also involved trapezium in three patients and avascular changes were evident in two patients with waist fracture.

In patients whose bone quality is poor where significant degenerative changes were already evident, reconstructive bone graft procedures are no longer applicable. Limited arthrodesis [7,17] and proximal row carpectomy [1,12] are an alternative for this situation. Additionally there can be complications related to metal hardware, postoperative instabilities and cosmetic problems.

Excision of carpal scaphoid for treatment of non-union was reported as early as 1905 by Codman and Chase [3]. The concept of decompression of the radial side of the wrist to retain the radiocarpal joint and wrist stability, while eliminating current degenerative changes, for scaphoid nonunion has been published by Ruch et al [9] and subsequently by Malerich et al [6]. More recently Ruch revised the procedure into a less invasive arthroscopic distal scaphoid resection arthroplasty [10]. The operative indication of Malerich was non-union related arthritis without proximal scapholunatecapitate joint involvement. However in this series, five patients with SLAC stage II and two patients with stage III were included and presented good pain relief and gained range of motion. Regarding pain relief, six out of seven patients complained of no or minimal pain after the operation. This is comparable to other distal scaphoid resection arthroplasty and other motion preserving procedures like four-corner fusion and proximal carpectomy. Theoretically excision of distal fragment eliminates the mechanical catching and impingement symptoms caused by motion at
the non-union site, thus there is no chance of impingement between the radial styloid and scaphoid.

Regarding range of motion and grip power, the procedure presented results similar to those obtained by Ruch et al. comparable to other motion preserving procedures. Also the grip strength was also improved.

Our radiographic results are similar to the radiographic results reported by Malerich et al [6]. However, the significant finding in our study was the progression of the radiographic index that occurred in two patients. Two patients (Case 2 and 3) who’s radiological index progressed more than 20° up were subjectively satisfied.

Another advantage of this procedure is that it provides better grip strength and range of motion especially in extension, as it preserves dorsal structures.

The distal scaphoid resection arthroplasty requires a short immobilization period, and thus makes it possible for the patient to return to work earlier.

Although this study has limitations such as a small number of patients, heterogeneous fracture level and limited follow up our findings may help other surgeons to advise treatment for advanced degenerative arthritis due to scaphoid nonunion.
References


