Primary semi-constrained arthroplasty for chronic fracture-dislocations of the elbow

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We present six patients with chronic dislocation of the elbow who were treated by primary semiconstrained total elbow arthroplasty. All were women with a mean age of 65 years (51 to 76), the mean interval between dislocation and surgery was 17 weeks (5 to 52) and the mean follow-up 58 months (24 to 123).

The most dramatic improvement was in function. The mean American Shoulder and Elbow Surgeon score was 5.2 times better (p < 0.001) and the mean total range of movement increased from 33˚ to 121˚ (p < 0.001) after operation. Three patients developed wear of polyethylene. One required revision for a periprosthetic fracture, and another required a bushing exchange.

Primary semiconstrained elbow arthroplasty provides significant, predictable functional improvement. Potential solutions for wear of polyethylene include a different operative technique or design of implant. Despite the high incidence of such wear, total elbow arthroplasty should be considered as a viable treatment option for chronic dislocation of the elbow in elderly patients.

Recurrent instability of the elbow can often be successfully treated by ligament repair or reconstruction, whereas chronic or unreduced dislocation is associated with significant soft-tissue contracture. The latter requires extensive soft-tissue release to reduce the joint, and in this setting, articular congruency can only be maintained by strict immobilisation and probable loss of movement or by ligamentous reconstruction and the application of a dynamic external fixator. Even if dislocation of the elbow is treated quickly, satisfactory results are not guaranteed, especially in older patients. Ring et al11 reported a series of 11 patients with a mean age of 49 years (17 to 70) with complex posterior dislocations of the elbow which had been treated by primary open reduction and internal fixation (ORIF). Seven had an unsatisfactory result at the latest follow-up examination.

There are many ways to treat chronic fracture-dislocation of the elbow, including ORIF and arthroplasty. Although open reduction with soft-tissue reconstruction or minimal fixation has been successfully reported by a few authors, most of the patients in these studies were less than 60 years of age. The rate of complications of ORIF is relatively high. Nerve injury, most commonly transient, has been reported in up to 40% of cases. Naidoo reviewed a series of 23 patients with a mean age of 30 years (10 to 60), with unreduced posterior dislocation of the elbow. The duration of the dislocation ranged from one month to two years. Open reduction was performed in all cases with release of contracture and pinning of the ulno-humeral joint. Only ten of the 23 patients achieved an arc of movement greater than 90˚. While ORIF can be effective for relief from pain, the functional results are unpredictable and often unsatisfactory because patients are unable to perform the essential activities of daily living. Furthermore, in elderly patients with inflammatory or post-traumatic arthritis, ORIF may restore movement but the joint remains painful.

There have been few reports of treatment by primary total elbow arthroplasty for chronic dislocation, despite the fact that elbow arthroplasty after trauma or nonunion is well accepted. Ramsey et al described 19 patients with chronic instability who had been treated by semiconstrained total elbow arthroplasty. Most had an unstable nonunion of a fracture of the distal humerus and had had a mean of 2.3 previous operations. The mean Mayo score improved from 44 points before to 86 after operation. The mean post-operative range of movement was 25˚ to 128˚. Sixteen patients described little or no pain after the...
arthroplasty, and the remainder reported moderate pain. Overall, 16 of the 19 patients had a good or excellent result after six years.

Our aim was to report the medium-term outcome of primary semiconstrained total elbow arthroplasty in older patients with chronic dislocation of the elbow and post-traumatic arthritis.

Patients and Methods
An institutional review board-approved retrospective review was performed on six consecutive patients with chronic unreduced posterior dislocation of the elbow which had been treated by primary semiconstrained total elbow arthroplasty. The indications for total elbow arthroplasty had been based on several factors, including pain, the age of the patients, the quality of bone, the level of activity, a history of rheumatoid arthritis, and failed attempts at reduction or fixation. Inclusion criteria were based on age greater than 50 years, chronic dislocation with soft-tissue contracture, severe pain and loss of function and a minimum follow-up of two years. Patients excluded were those with active infection, an inability to participate in a post-operative programme of physiotherapy because of dementia, or an occupation requiring repetitive lifting of greater than 4.5 kg (10 lb).

All six patients were female with a mean age of 65 years (51 to 76); an age range considered by many to be higher than that recommended for reconstruction.20 The mean follow-up was 58 months (24 to 123; Table I). The dominant limb was involved in four patients and the mean interval between dislocation and surgery was 17 weeks (5 to 52). All patients had radiological evidence of post-traumatic arthritis. The two patients with rheumatoid arthritis did not have pre-existing active disease in the elbow. Five patients had fracture-dislocations and one had a chronic posteromedial dislocation without fracture. Four patients sustained a ‘terrible triad’ injury (coronoid fracture, fracture of the radial head, and posterior dislocation of the elbow) resulting in chronic instability, and one had non-union of a distal humeral fracture. Three patients had type-III coronoid fractures30 (Fig. 1) and four had a fracture of the radial head. The initial treatment of these patients is given in Table I.

![Fig. 1a](image1.png)  ![Fig. 1b](image2.png)

Pre-operative a) AP and b) lateral radiographs of a type-III coronoid fracture.

Operative technique. A posterior approach was used in all patients, followed by neurolysis and anterior transposition of the ulnar nerve. In five cases the approach of Bryan and Morrey31 was performed in which the extensor mechanism was subluxed laterally. A Chevron osteotomy was used for one patient and the proximal olecranon segment reflected, allowing access to the joint for the placement of the components. The radial head was resected in three patients and triceps lengthening was not performed in any. The Conner-Morrey semiconstrained total elbow prosthesis (Zimmer, Warsaw, Indiana) was implanted in all patients using antibiotic-laden cement.32 The senior author (MAF) performed all the operations.

At the time of surgery, the following pathological changes were noted: triceps contracture, capsular thickening and contracture, foreshortening of the collateral ligaments, and arthritis of the ulnohumeral joint. If patients had undergone previous surgery, frozen sections were obtained and tissue was examined microscopically and cultured for evidence of infection. The patients were placed in an anterior plaster splint for 48 hours after the operation with the elbow held in extension.

Table I. Details of the patients and operations

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yrs)</th>
<th>Gender/ arm</th>
<th>Time of dislocation (wks)</th>
<th>Follow-up (mths)</th>
<th>Injury*</th>
<th>Initial treatment†</th>
<th>Radial head resection</th>
<th>Type of arthritis‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76</td>
<td>F/R</td>
<td>6</td>
<td>72</td>
<td>Radial head fx; type-III coronoid fx; dislocation</td>
<td>Failed ORIF</td>
<td>No</td>
<td>PTA/RA</td>
</tr>
<tr>
<td>2</td>
<td>62</td>
<td>F/R</td>
<td>6</td>
<td>123</td>
<td>Radial head fx; type-III coronoid fx; dislocation</td>
<td>Missed Dx</td>
<td>Yes</td>
<td>PTA</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
<td>F/L</td>
<td>5</td>
<td>48</td>
<td>Radial head fx; type-III coronoid fx; dislocation</td>
<td>Failed ORIF</td>
<td>No</td>
<td>PTA/RA</td>
</tr>
<tr>
<td>4</td>
<td>73</td>
<td>F/R</td>
<td>28</td>
<td>45</td>
<td>Distal humerus fx; dislocation</td>
<td>CR</td>
<td>Yes</td>
<td>PTA</td>
</tr>
<tr>
<td>5</td>
<td>73</td>
<td>F/R</td>
<td>7</td>
<td>36</td>
<td>Postero medial dislocation</td>
<td>CR</td>
<td>Yes</td>
<td>PTA</td>
</tr>
<tr>
<td>6</td>
<td>51</td>
<td>F/L</td>
<td>52</td>
<td>24</td>
<td>Radial head fx; type-I coronoid fx; dislocation</td>
<td>Sx</td>
<td>No</td>
<td>PTA</td>
</tr>
<tr>
<td>Mean</td>
<td>65</td>
<td></td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* fx, fracture  
† CR, closed reduction; Dx, diagnosis; ORIF, open reduction and internal fixation; Sx, surgery  
‡ RA, rheumatoid arthritis; PTA, post-traumatic arthritis
Evaluation. All patients were evaluated before and after operation using the American Shoulder and Elbow Surgeons scale (ASES). Clinical examination included an assessment of the active range of movement (ROM). The limits of extension and flexion, as well as the total arc of movement were recorded. Radiographs obtained included AP and lateral views of the affected elbow. The post-operative radiographs were evaluated for the formation of ectopic bone, progressive radiolucencies, and wear of polyethylene (Fig. 2).

Statistical analysis. The total ROM was calculated by subtracting extension from flexion. Post-operative values for pain, function, and ROM were all compared with their pre-operative values by using Student’s *t*-test. A p value of < 0.05 was considered significant.

Results

The mean ASES pain score at the last follow-up was three times better (*p* = 0.024) and the mean ASES function score 5.2 times better (*p* < 0.001) than the mean pre-operative scores (Fig. 3). Three patients reported no pain or mild pain, two reported their pain as moderate and one as severe. The mean total ASES score and total ROM also improved (Table II). Two patients had no movement in the elbow before operation. The mean total ROM improved from 33˚ before to 121˚ after operation (*p* < 0.001; Fig. 4).

Table II. Results after total elbow arthroplasty in the six patients

<table>
<thead>
<tr>
<th>Case</th>
<th>ASES*</th>
<th>ROM (˚)</th>
<th>Radiological findings</th>
<th>Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-op</td>
<td>Post-op</td>
<td>Pre-op</td>
<td>Post-op</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>100</td>
<td>0</td>
<td>20 to 120</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>88</td>
<td>30 to 40</td>
<td>0 to 140</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>53</td>
<td>60 to 100</td>
<td>5 to 130</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>35</td>
<td>0</td>
<td>20 to 130</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>62</td>
<td>30 to 90</td>
<td>15 to 120</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>87</td>
<td>0 to 90</td>
<td>5 to 120</td>
</tr>
<tr>
<td>Mean</td>
<td>17.8</td>
<td>70.8</td>
<td>20 to 53</td>
<td>11 to 132</td>
</tr>
</tbody>
</table>

*p value of difference < 0.001 < 0.001

* American Shoulder and Elbow Surgeons score33
Radiological review. Formation of ectopic bone was not a significant problem with respect to post-operative function. Radiolucencies around the humeral component occurred in two patients, one in conjunction with asymmetrical wear of polyethylene. A total of three patients developed eccentric wear of polyethylene (Table II).

Complications. Wear of polyethylene was the most common complication. The patient (case 1) with both eccentric wear of polyethylene and radiolucency also developed an asymptomatic fibrous union of the olecranon process. Six years after the primary arthroplasty, this patient fell and sustained a periprosthetic fracture of the humerus which required revision (Table II). It was noted that there was significant osteolysis around the humeral component, which may have contributed to the periprosthetic fracture. Another patient required revision for bushing exchange only (Fig. 5). Radiological and intra-operative evaluation of the ulnar and humeral components showed them to be well fixed. The third patient with wear of polyethylene was recommended to have a revision, but declined.

Discussion
The results of our medium-term study clearly show that primary elbow arthroplasty results in a significant decrease in pain and a dramatic increase in function and ROM. The results complement studies showing the efficacy of primary elbow arthroplasty in elderly patients for other indications, such as failed ORIF, nonunion, acute fracture-dislocation, and fracture of the distal humerus and demonstrate that chronic dislocation and fracture-dislocation should be added to this list. While other treatments may also reduce pain, total elbow arthroplasty provides immediate stability and allows patients greater functional recovery and a quicker return to activities of daily living. Notably, it was successful in patients with both post-traumatic and rheumatoid arthritis and should be considered as a treatment option to restore function in patients with chronic dislocation and inflammatory or post-traumatic arthropathy. A linked implant was strongly recommended, in order to compensate for incompetent collateral ligaments associated with chronic dislocation.

Wear of polyethylene was the most common complication seen at medium term follow-up (50%). This may be explained by the lack of collateral ligaments to protect the bushing from off-axis loading, higher bearing stresses, and accelerated localised wear. When collateral ligaments are absent, varus and valgus forces cause misalignment of the joint and a concentration of forces on small contact areas of the polyethylene bushings, thereby increasing bearing stresses and placing the material in conditions beyond its designed indications. Thus, these polyethylene bushings are susceptible to early failure as well as subsequent synovitis because of particulate debris and aseptic loosening. Similar failures have also been reported in other series in which total elbow arthroplasty was used notably that of Wright and Hastings who reported ten patients with peri-implant osteolysis at a mean follow-up of 60 months (9 to 159) after implantation of a Coonrad-Morrey total elbow replacement. Metal and particulate debris was seen in the peri-prosthetic space in all cases.

Based on the radiological finding of eccentric wear of polyethylene in our study, we have now changed our surgical technique. Previously, because chronic fracture-dislocations require extensive releases to restore movement, the collateral ligaments were routinely sacrificed for exposure in cases in which the triceps was subluxed laterally. Instead, we now split the triceps tendon in the midline and release the soft tissues from the bone as continuous sleeves of tissue. The entire soft-tissue sleeve is repaired back to bone after implantation. It is hoped that this will allow the collateral ligaments to reattach and protect the polyethylene.

In conclusion, our findings demonstrate that linked semiconstrained total elbow arthroplasty is a predictable method for decreasing pain and restoring function to arthritic patients with chronic elbow dislocation or fracture-dislocation. The functional improvement afforded by this procedure allowed patients to return to activities of daily living, a key factor to be considered in an analysis of surgical success. Although wear of polyethylene was a frequent complication in our study, the noted modifications to the surgical technique may reduce this problem.

References


36. Wright TW, Hastings H. Total elbow arthroplasty failure due to C-ring failure and or bushing wear. Procs American Shoulder and Elbow Surgeons annual meeting. 2002.