The souter-strathclyde elbow prosthesis in rheumatoid patients : an in-depth clinical, radiological and biomechanical analysis

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PRIMARY SOUTER-STRATHCLYDE TOTAL ELBOW PROSTHESIS IN RHEUMATOID ARTHRITIS

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Abstract

Background: Total elbow arthroplasty is a well-established treatment for the painful elbow joint in patients with rheumatoid arthritis. We present the results of what we believe to be the first prospective study of the Souter-Strathclyde total elbow prosthesis.
Methods: Between June 1982 and December 2000, 204 primary total elbow prostheses were inserted in 166 patients who had rheumatoid arthritis. No patient was lost to follow-up. The mean duration of follow-up was 6.4 years. All patients were examined preoperatively, at one and two years postoperatively, and at regular intervals thereafter.
Results: Six of the 204 elbows had pain at rest at the time of the latest follow-up. Ten patients (ten elbows) without previous neurological symptoms had development of paresthesias in the distribution of the ulnar nerve postoperatively. Patients who had pain at rest or at night and those who had ulnar nerve symptoms preoperatively were found to have a significant chance of having the same complaints postoperatively. Pain at rest or at night and a decrease in function during the follow-up period were associated with humeral loosening. Twenty-four elbows had revision of the total elbow prosthesis because of loosening of the humeral component (ten), loosening after fracture (six), dislocation (four), infection (two), restricted range of motion (one), or fracture of the middle part of the humeral shaft, proximal to the prosthesis (one). One prosthesis was removed because of humeral loosening, and eight were removed because of deep infection. Another five prostheses were radiographically loose at the time of the latest follow-up. The rate of implant survival, according to the method of Kaplan-Meier, was 77.4% after ten years and 65.2% after eighteen years.
Conclusions: Total elbow replacement is associated with a high complication rate and therefore may be warranted only for seriously disabled patients. Currently, the results associated with the Souter-Strathclyde total elbow prosthesis are comparable with the results associated with other prostheses, but loosening of the humeral component remains a concern.

Introduction

Total elbow arthroplasty is a well-established treatment for advanced arthropathy of the elbow joint, especially in patients with rheumatoid arthritis. In patients with advanced rheumatoid disease, the postoperative clinical results of total elbow arthroplasty are better than those of other treatments such as synovectomy (with or without resection of the radial head) or fascial excision arthroplasty[1,2]. In our center, the Souter-Strathclyde total elbow prosthesis (Stryker Howmedica Osteonics, Limerick, Ireland) was first used in June 1982 for primary total elbow replacement and was subsequently used for revision operations[3,4]. In the present report, we describe the long-term results for 204 elbows that were treated with this nonconstrained, cemented prosthesis. All prostheses were inserted at our center with use of the same technique, and none of the elbows were lost to follow-up. We believe that the present investigation represents the first prospective study of the Souter-Strathclyde total elbow prosthesis. The purpose of the present investigation was to contribute to the understanding of the results associated with this device in patients with rheumatoid arthritis.

Materials and Methods

Between June 1982 and December 2000, 204 total elbow prostheses were inserted in 166 patients at our department. None of the patients had had a previous total elbow arthroplasty of the same joint. Thirty-eight patients had a bilateral procedure. The mean duration of follow-up was 6.4 years (range, two to nineteen years). Forty-one elbows were followed for longer than ten years.

The patients included 117 women and forty-nine men. The average age of the patients at time of the operation was sixty-one years (range, twenty-four to eighty-three years). The average age of the men was sixty years, and the average age of the women was sixty-two years. The operation was performed in 119 right elbows and eighty-five left elbows. Two surgeons performed all of the operations, although the senior author (P.M.R.) inserted most (173) of the prostheses.

All patients had advanced rheumatoid arthritis. The diagnosis was seropositive rheumatoid arthritis for 183 elbows, seronegative rheumatoid arthritis for sixteen elbows, and juvenile rheumatoid arthritis for five elbows. The indications for the insertion of a total elbow prosthesis were pain in and restriction of motion of the elbow joint combined with grade-III, IV, or V destruction of the elbow joint according to the radiographic criteria of Larsen *et al*[5]. Preoperatively, sixteen elbows (8%) had Larsen grade-III changes, ninety (44%) had Larsen grade-IV changes, and ninety-eight (48%) had Larsen grade-V

changes. The mean time between the diagnosis of rheumatoid arthritis and the insertion of the prosthesis was 19.1 years (range, one to fifty-nine years); the mean interval was 15.3 years for men and 20.6 years for women (Student t test, $p < 0.01$). Thirty-two elbows had been treated with synovectomy at a mean of 3.9 years before insertion of the prosthesis; in fourteen of these elbows, synovectomy had been performed in combination with excision of the radial head.

Preoperatively, forty patients (forty-three elbows; 21%) were unable to work, seventy-one patients (eighty-five elbows; 42%) could perform light housework, and thirty-one patients (forty-seven elbows; 23%) could perform light manual work. The remaining twenty-four patients (twenty-nine elbows; 14%) were able to perform most daily tasks. Forty-five elbows (22%) had no pain at rest, sixty-nine (34%) had mild pain, sixty-five (32%) had moderate pain, and twenty-five (12%) had severe pain.

All patients were examined by the senior author and were assessed clinically and radiographically before the operation, at one and two years after the operation, and then at regular intervals thereafter with use of a shortened version of the assessment developed by Souter[6]. The data for all patients were collected with MRDM software (Medical Research Data Management, www.clinicalresearch.nl). This software was converted into SPSS (SPSS, Chicago, Illinois) for the data analysis.

Forty-four patients (fifty-five elbows) died of unrelated causes at a mean of 6.5 years after the operation. Two patients, who had the operation in 1993 and 1996, were followed for two and four years, respectively, but could not be traced after that time. Twenty-four elbows were revised at a mean of 4.6 years postoperatively because of loosening of one or two components (ten), loosening after fracture (six), dislocation (four), infection (two), diaphyseal humeral fracture (one), and restricted range of motion (one). Another nine patients (nine elbows) had an excision arthroplasty.

The Prosthesis

The Souter-Strathclyde total elbow prosthesis was developed in 1973 and was first inserted in 1977. The humeral component is made of Vitallium and has a flat intramedullary stem for fixation in the epicondylar ridges, with flanges for the capitellum and medial epicondyle of the humerus. The ulnar component is made of ultra-high-molecular-weight polyethylene and has a keel and a small stem. Both components were fixed with Palacos cement (Schering-Plough, Kenilworth, New Jersey). Different sizes are available for both components. A snap-fit metal-backed ulnar component was developed to increase stability in elbows that may be unstable. We used sixty-two small, 102 medium, twenty-seven large, and thirteen medium long-stemmed humeral components (Fig. 1) and ninety-two small, ninety-two medium, and twenty metal-backed ulnar components

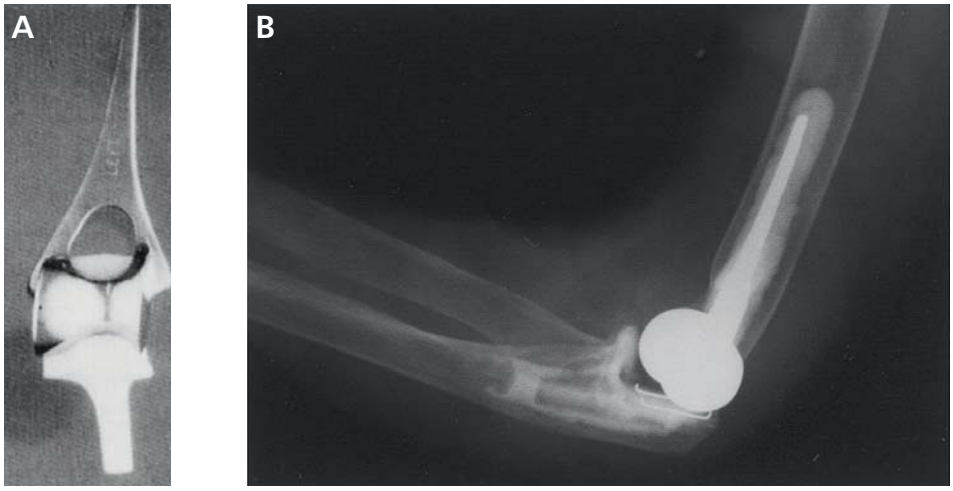

Fig. 1. Preoperative anteroposterior photograph (a) and postoperative lateral radiograph (b) showing the long-stemmed humeral component and standard-sized ulnar component.

with a 5cm stem. Fifteen of the twenty metal-backed ulnar components had a snap-fit design. The determination of the component sizes was made preoperatively with use of templates.

Operation

The operation was carried out by one of two surgeons with use of the same technique[4,7]. Prophylactic intravenous antibiotics were routinely employed.

Until 1994, the fibrous arch that covers the ulnar sulcus was incised only in patients who had preoperative complaints related to the ulnar nerve. Since 1994, this release has been performed routinely. In eighty-two elbows (40.2%), a humeral bone plug was used and the cement was pressurized into the bone marrow during insertion of the prosthesis. This procedure has been used routinely since 1994. The mean duration of the operation was 165 minutes (range, eighty-five to 275 minutes). An ipsilateral shoulder arthroplasty was performed in eight patients, and an arthrodesis of the ipsilateral wrist was performed in three patients at the same time.

Postoperative Treatment

The patients were treated with a compression dressing for five days postoperatively, followed by collar-and-cuff immobilization. Passive and active flexion and extension ex-

ercises were started on the fifth day under the supervision of a physiotherapist. All patients were treated with a posterior splint at night for six weeks postoperatively.

Intraoperative Complications

In five elbows, the medial epicondyle (four) or the lateral epicondyle (one) was fractured during the trial insertion of the standard (short-stemmed) humeral component. Because of the fractures, a long-stemmed humeral component was used.

Statistical Analysis

The Cox model was used to investigate the effect of different component sizes and the use of a bone plug on the rate of revision, with the level of significance set at $p < 0.05$. Pain, function, and ulnar nerve dysfunction after the operation were analyzed by means of a generalized linear mixed model with multivariate normal random effects with use of penalized quasi-likelihood, with the level of significance set at $p < 0.05$[8,9]. Housekeeping ability, an ordinal variable, was analyzed in a standard linear mixed-effects model with use of maximum likelihood, with the level of significance set at $p < 0.05$. The Pearson chi-square test for independence was used first for the correlation between incision of the ulnar arch and the presentation of postoperative complaints related to the ulnar nerve and second for the correlation between the use of a humeral bone plug and humeral loosening, with the level of significance set at $p < 0.05$. Finally, the Kaplan-Meier method was used to analyze the overall survival of the prosthesis, with removal of the prosthesis (with or without revision) as the end point. All data were analyzed with use of S-PLUS software (Insightful, Seattle, Washington).

Results

The clinical results are summarized in Table I.

Pain

At the time of the latest follow-up, 139 (68.1%) of the 204 elbows had no pain, six (2.9%) had pain at rest, and fifty-nine (28.9%) had occasional pain with loading or stress. One hundred and seventy-one elbows (83.8%) had improved strength after the operation, eight (3.9%) had worse strength after the operation, and twenty-five (12.3%) had no change in strength after the operation. There was a trend toward an increase in pain with time since the operation. All four measures of pain (pain at rest, pain at night,

Table I. Clinical data

				Results of Regression Analysis		
	2 Years ± 6 Months Post-operatively	5 Years ± 6 Months Post-operatively	>10 Years Postoperatively	Change in Prevalence of Finding over Time	Relationship Between Presence of Finding Preoperatively and Development of Same Finding Postoperatively	Chance of Humeral Loosening if Finding Present Postoperatively
Number of elbows	170	89	53			
Pain*						
At rest	18	13	13	Increased ($p = 0.04$)	Positive ($p = 0.02$)	Enhanced ($p < 0.001$)
At night	24	15	14	Increased ($p = 0.001$)	Positive ($p = 0.01$)	Enhanced ($p < 0.001$)
With movement	29	18	16	Increased ($p = 0.01$)	Positive (NS†)	Enhanced (NS†)
With loading	38	19	21	Increased ($p = 0.02$)	Positive (NS†)	Enhanced (NS†)
Severity of pain*						
Occasional	32	24	9	Increased (NS†)‡	Positive (NS†)‡	Enhanced (NS†)‡
Mild	10	6	5			
Moderate	9	4	5			
Severe	2	1	3			
Ulnar nerve symptoms*						
Pain	6	3	3	§	§	
Paresthesias	27	17	10	Increased (NS†)	Positive ($p = 0.001$)	
Weakness	9	3	1	§	§	
Housekeeping ability*						
All tasks	23	15	9	Increased (NS†)		
Most tasks	57	34	8			
Light tasks	74	32	24			
Unable to perform any tasks	16	8	11			

Table I. Clinical data *(continued)*

				Results of Regression Analysis		
	2 Years ± 6 Months Post-operatively	5 Years ± 6 Months Post-operatively	>10 Years Postoperatively	Change in Prevalence of Finding over Time	Relationship Between Presence of Finding Preoperatively and Development of Same Finding Postoperatively	Chance of Humeral Loosening if Finding Present Postoperatively
Function*						
Lift hand to mouth	159	86	51	Increased (NS†)	Positive (NS†)	Enhanced ($p < 0.001$)
Move hand to perineum	144	79	40	Decreased (NS†)	§	Enhanced ($p = 0.02$)
Lift kettle with ipsilateral hand	130	74	30	Decreased (NS†)	Positive ($p = 0.01$)	Enhanced ($p < 0.01$)
Lift kettle with two hands	157	83	48	Decreased (NS†)	Positive (NS†)	Enhanced ($p = 0.04$)
Lift teacup with ipsilateral hand	156	84	44	Increased (NS†)	Positive ($p = 0.03$)	Enhanced ($p < 0.001$)
Movement# (deg)						
Flexion deformity	32.4 ± 13.1	32.0 ± 15.0	33.5 ± 14.2			
Flexion	136.3 ± 9.8	132.2 ± 20.5	133.4 ± 10.9			
Pronation	73.9 ± 16.2	74.4 ± 15.3	76.6 ± 13.2			
Supination	58.2 ± 25.6	54.7 ± 26.2	64.2 ± 22.8			

*The data under each postoperative interval are given as the number of elbows. †NS = not significant. ‡The severity of pain was analyzed as a linear model. §No results could be obtained. #The data are given as the mean and the standard deviation.

pain with movement, and pain with loading or stress) increased during the follow-up period ($p < 0.05$). The severity of pain also increased with time, although this increase was not significant.

Function

Motion improved after the operation; specifically, the mean range of flexion increased from 109° to 134°, the mean range of supination increased from 34° to 57°, and the mean range of pronation increased from 60° to 75°. The mean flexion deformity increased from 32° to 33°. None of the five elbow functions that were assessed changed significantly during the follow-up period.

Ulnar Nerve

Preoperatively, thirty-one patients (thirty-six elbows) had paresthesias in the distribution of the ulnar nerve. In twenty patients (twenty-two elbows), this complaint resolved postoperatively. Ten patients (ten elbows) without previous neurological symptoms had development of paresthesias in the distribution of the ulnar nerve postoperatively; in eight patients (eight elbows), the paresthesias developed within three months of follow-up. In three patients (three elbows) with complete loss of sensitivity, release of the ulnar nerve was performed within one week. The other seven patients (seven elbows) with paresthesias or pain were treated nonoperatively. Of the ten patients with new complaints, eight had no complaints related to the ulnar nerve at the time of the latest follow-up and two had paresthesias of the ulnar nerve sometimes but the complaints did not interfere with the activities of daily life. The prevalence of postoperative complaints related to the ulnar nerve decreased from twenty of eighty-six among elbows treated before 1994 to eighteen of 118 among elbows treated after 1994, but this difference was not significant (Pearson chi-square test for independence).

Size of Components

Despite the trend in the literature[10,11] toward the use of large and long-stemmed humeral components and metal-backed snap-fit ulnar components, we still prefer standard components because of the small amount of bone that has to be removed before insertion. In the present study, no significant difference could be found between sizes of components and the survival rate ($p = 0.20$ and $p = 0.09$), even after exclusion of the long-stemmed components.

Use of Humeral Bone Plug

In the present series, no significant difference in the prevalence of humeral loosening was observed between elbows treated with and without the use of a humeral bone plug (Pearson chi-square test for independence).

Relationship Between Preoperative Status and Postoperative Outcome

The relationship between preoperative clinical scores and outcome is of importance. If a patient had pain at rest or at night before the operation, there was a significant chance that pain at rest or at night would develop after the operation. With regard to function, the preoperative ability to lift a kettle or teacup with the ipsilateral hand seemed

to enhance the chance that the patient would have the same ability postoperatively ($p \leq 0.03$). For all other activities tested, better function of the rheumatoid elbow before the operation seemed to ensure better function after the operation.

Patients with paresthesias in the distribution of the ulnar nerve before the operation had a high risk for the development of ulnar complaints after the operation ($p < 0.01$). Release of the ulnar arch (routinely performed after 1994) did not change this relationship.

Prognostic Factors for Humeral Loosening

With the numbers available, gender, age, Larsen classification, use of a humeral bone plug, and the length of time between the diagnosis of rheumatoid arthritis and the total elbow arthroplasty did not significantly increase the chance of humeral loosening.

If pain at rest or at night was present during the follow-up assessments, the chance of humeral loosening was increased ($p < 0.001$). Restriction of function during the follow-up period also enhanced the chance of humeral loosening; this relationship was significant for all functions measured (Table I).

Complications

The complication rate was 29.9% (Table II). The total elbow prosthesis was revised in twenty-four elbows because of loosening of the humeral component (ten), fracture of the distal part of the humerus or proximal part of the ulna with secondary loosening (six), dislocation (four), infection (two), restricted range of motion (one), and fracture of the humerus proximal to the prosthesis necessitating revision with a long-stemmed humeral component (one). One prosthesis was removed because of humeral loosening, and ten were removed because of deep infection (Table III). In three elbows the infection occurred early (one, three, or four months after surgery), whereas in seven elbows the infection occurred at an average of seven years (range, two to fourteen years) postoperatively. The infection was eradicated in all ten elbows after resection arthroplasty and appropriate antibiotic therapy. Eight elbows did not have a reoperation after the resection arthroplasty. At the time of the most recent follow-up, all were free of pain but had restriction of function because of instability. In three of the ten elbows that were revised because of loosening of the humeral component, the ulnar component was left in situ. Three prostheses that were revised with a long-stemmed humeral component loosened again after an average of 4.1 years. Re-revision was performed with a long-stemmed component of the same size combined with bone-grafting. In another two elbows, the site of the revision arthroplasty became infected after seventy-one and thirty-one

Table II. Complications associated with 204 primary Souter-Strathclyde total elbow prostheses used for the treatment of rheumatoid arthritis

Complications	
Intraoperative	
Fracture of medial epicondyle of humerus	4 (2.0%)
Fracture of lateral epicondyle of humerus	1 (0.5%)
Postoperative	
Revision for humeral loosening	10 (4.9%)
Removal for humeral loosening	1 (0.5%)
Revision for fracture and secondary humeral loosening	4 (2.0%)
Revision for fracture and secondary ulnar loosening	2 (1.0%)
Dislocation	
• Conservative treatment	3 (1.5%)
• Revision	4 (2.0%)
Removal for infection	10 (4.9%)
Excision of infectious rheumatoid nodules	4 (2.0%)
Complaints related to ulnar nerve	
• Release of ulnar nerve	3 (1.5%)
• Paresthesias (conservative treatment)	3 (1.5%)
• Paresthesias and pain (conservative treatment)	4 (2.0%)
Fracture of humerus	
• Revision of humeral component	1 (0.5%)
• Immobilization for six weeks	1 (0.5%)
Revision for restricted range of motion	1 (0.5%)
Radiographic loosening of humeral component	5 (2.5%)
Total	61 (29.9%)

months; both elbows were treated with resection arthroplasty. None of the latter five elbows were painful, and no complications were seen at the time of the latest follow-up.

Nine patients had development of infected rheumatoid nodules in the involved elbow years after the operation. Four patients (four elbows) that had a superficial infection were treated with excision of the nodules and antibiotics, with the prosthesis left in situ. Three of these patients were asymptomatic at the time of the most recent follow-up; the fourth patient still had purulent drainage from the nodules but removal of

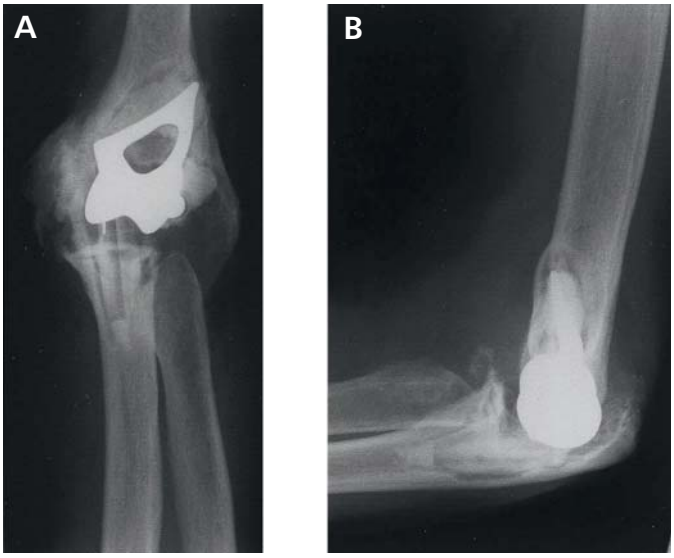

Fig. 2. Anteroposterior (a) and lateral (b) radiographs showing loosening and migration of the standard humeral component. The patient did not have clinical complaints related to the elbow joint.

Table III. Complications associated with 204 primary Souter-Strathclyde total elbow prostheses used for the treatment of rheumatoid arthritis

Reason for Removal of Prosthesis	Number of Elbows	Treatment (Number of Elbows)
Loosening of humeral component	11 (5.4%)	Revision (10), resection arthroplasty (1)
Fracture and secondary humeral loosening	4 (2.0%)	Revision (4)
Fracture and secondary ulnar loosening	2 (1.0%)	Revision (2)
Infection	10 (4.9%)	Resection arthroplasty (8), revision (2)
Dislocation	4 (2.0%)	Revision of ulna with a metal-backed snap-fit component (4)
Fracture of humerus proximal to prosthesis	1 (0.5%)	Revision with a long-stemmed humeral component (1)
Restricted range of motion	1 (0.5%)	Revision (1)
Total	33 (16.2%)	

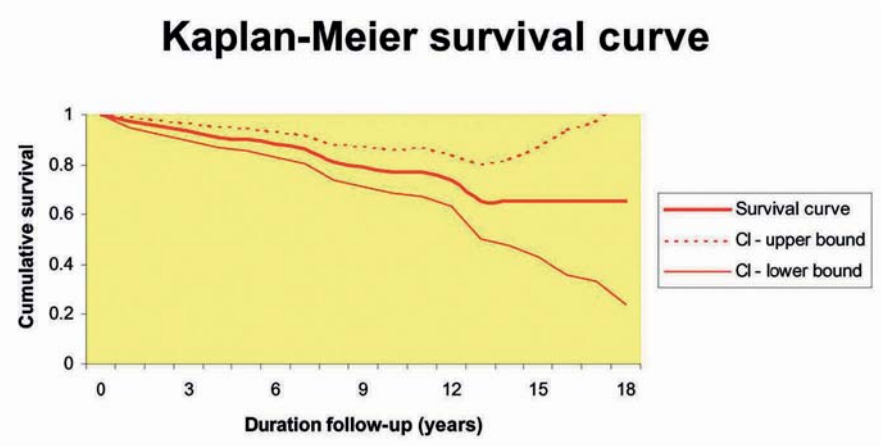

Fig. 3. Kaplan-Meier curve illustrating the survival of the primary Souter-Strathclyde total elbow prosthesis when used for the treatment of rheumatoid arthritis, with revision as the end point. CI = 95% confidence interval.

the prosthesis was not indicated because of poor general health status. The other five patients (five elbows) initially had a superficial infection, but by the time that they were evaluated a deep infection had developed. In all five cases, the prosthesis was removed as described above.

Seven elbows dislocated within the first few months after surgery. All seven elbows initially were treated with closed reduction and two weeks of immobilization. Three elbows had no additional dislocations. The other four could not be sufficiently reduced, but the patients refused surgical treatment because of the absence of clinical complaints. After a few years, however, all four elbows were painful and were revised with use of a snap-fit ulnar component. None of the four elbows had additional dislocations of the prosthesis.

Three patients had release of the ulnar nerve within four weeks after the original arthroplasty because of sensory and motor impairment. The ulnar nerve complaints resolved in all three patients following surgery.

Radiographic Evaluation

Radiographs were made for all patients at the time of the latest follow-up. Five patients (five elbows) had radiographic signs of loosening according to the criteria of Souter[6] (a complete, progressive radiolucent line of >1 mm around the component) (Fig. 2). These patients did not have clinical complaints, and a revision operation was not recommended.

At the time of the latest follow-up, partial radiolucent lines were detected around the proximal part of the humeral component in sixty-two elbows (36.3%) and in the supracondylar area in fifty-two elbows (30.4%).

At the time of the last follow-up, radiolucent lines were seen along the ulnar shaft in twenty-four elbows (14.0%) and around the olecranon in fifty-four elbows (31.6%). No migration of any humeral or ulnar component was noted at the time of the latest follow-up.

Survival

Kaplan-Meier analysis with removal of the prosthesis (with or without revision) as the end point showed an overall survival rate of 90.1% (95% confidence interval, 85.6% to 94.6%) after five years, 77.4% (95% confidence interval, 68.7% to 86.0%) after ten years, and 65.2% (95% confidence interval, 24.3% to 100.0%) after eighteen years (Fig. 3). All elbows, including those in which the prosthesis was revised or removed during the first few months, were taken into account. Overall, 94.9% of all 166 patients were very satisfied with the prosthesis at the time of the latest follow-up and stated that they would undergo this operation again.

Discussion

The present study confirms the results associated with the Souter-Strathclyde prosthesis as reported in previous studies[12-17]. Overall, we found a removal rate of 16.2% and a complication rate of 29.9%. These rates are in accordance with those associated with other total elbow arthroplasties[18-21] .

Unlike previous investigators, we counted all elbows, even when the implant had been removed or revised within a few months after the procedure. Strikingly, none of the elbows with more than thirteen years of follow-up were revised after this period. The overall rate of survival of the primary Souter-Strathclyde elbow prosthesis in the present study was equal to those reported in other recent studies[13,17] .

Most studies in the literature have involved the use of standard elbow-scoring systems developed by different authors, with the result being rated on a scale from 0 to 100 points. A reliable comparison between these studies is not possible because of the different weights for each of the scored items[22,23]. Because pain is the most important indication for a total elbow prosthesis in patients with rheumatoid arthritis, most patients are satisfied after the operation and, remarkably, 94.9% of the patients in the present series stated that they would undergo this operation again.

Trail *et al*. noted differences in the survival rate in association with the use of different component sizes[11]. The use of a long-stemmed humeral component combined with a metal-backed ulnar component, with or without a snap-fit, seems to be associated with a decreased rate of early loosening when compared with the use of standard-sized components. However, less bone stock is left when the larger components are used for primary surgery, and this can complicate fixation when revision is required. In the present series, we did not observe any differences in the survival rate among components of different sizes. For this reason, we prefer to use the short-stem standard ulnar component (small or medium) and the short-stem standard humeral component (small, medium, or large) for primary total elbow replacement in patients with normal amounts of bone loss.

In hip and knee replacement, the use of a femoral bone plug reduces blood loss and improves the mantle of cement around the prosthesis[24-26]. However, we did not observe any improvement in terms of clinical or radiographic outcome in association with the use of a bone plug in the humerus.

For radiographic follow-up, we used only conventional radiographs in two planes. In a previous study in which radiostereometry was used, eight (44.4%) of eighteen elbows had signs of aseptic loosening of the humeral component in the first two years after insertion of the Souter-Strathclyde prosthesis[27]. In contrast, with use of conventional radiographs, we found a loosening rate of only 7.8%. This difference may be related to the fact that loosening that is detectable with radiostereometry precedes loosening that is detectable with conventional radiographs. The importance of the location and thickness of radiolucent lines in relation to early loosening is still unclear. Other factors that may be important in the development of early loosening are the position of the prosthesis in the bone after insertion, the postoperative biomechanical axis, and the quality of the bone stock[28].

A relationship was found between the presence of preoperative symptoms (pain, restriction of function, and ulnar nerve complaints) and the chance that the same symptoms would develop postoperatively. Only for ulnar complaints has this relationship been described previously in the literature[19].

High rates of loosening of the humeral component have been described previously in the literature, but the reason for this complication is still not known[4,13,17,27]. In the series of Ikävalko et al.[10], long-stemmed humeral components showed a decreased rate of loosening compared with standard components.

Loosening of the prosthesis after fracture is of concern. In their series of 525 Souter-Strathclyde elbow prostheses, Ikävalko et al. described seven cases of loosening that were associated with fractures[13]. In the present study, six elbows had loosening of the prosthesis after a fracture; in all six cases, the olecranon or the distal part of the humerus

had fractured as the result of a fall or severe loading. Poor bone stock combined with excessive bone resection at the time of insertion of the prosthesis could play a role in this complication.

Incising the fibrous ulnar arch has become a routine part of our surgical technique, but routinely visualizing, releasing, and transposing the ulnar nerve remains controversial in the literature[6,14]. A surgeon can damage the ulnar nerve unnecessarily in patients with few or no complaints. However, we believe that incising the fibrous ulnar arch, with or without transposition of the ulnar nerve, is mandatory for patients with ulnar nerve compression symptoms before the operation. It is important to discriminate between preexisting and new postoperative ulnar nerve problems.

The dislocation rate in the present series (3.4%) was comparable with those in other reports[18,29]. All dislocations of the prosthesis occurred in the first few months after surgery. Although the Souter-Strathclyde prosthesis might be more constrained than other nonconstrained elbow prostheses, the quality and tension of the collateral ligaments after insertion of the prosthesis remain very important for the prevention of dislocation[21]. When the ligaments cannot be balanced and instability remains at the time of trial reduction, the surgeon might opt for the snap-fit ulnar component.

The reported rate of humeral loosening in elbows treated with the Souter-Strathclyde implant has varied in the literature, but Ikävalko et al. reported a loosening rate of 6% in their recent study of 525 Souter-Strathclyde prostheses[13]. The more frequent use of long-stemmed humeral components for primary surgery probably will reduce the rates of early loosening in the future.

We conclude that the primary Souter-Strathclyde prosthesis is a satisfactory solution for the treatment of severely symptomatic rheumatoid arthritis of the elbow. The need for minimal bone resection before insertion of the Souter-Strathclyde prosthesis provides a major advantage compared with other elbow prostheses, especially when the potential for revision operations is taken into account. Currently, the results associated with the Souter-Strathclyde total elbow prosthesis are comparable with those associated with other prostheses, but loosening of the humeral component remains a concern.

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