Souter-Strathclyde total elbow arthroplasty : medium-term results

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The Souter-Strathclyde unconstrained elbow prosthesis was prospectively studied in 36 patients (45 prostheses) with rheumatoid arthritis (Larsen grade 4 and grade 5). The mean age of the patients at the time of operation was 63 years (range : 39 to 75 years). Eight patients (9 prostheses) died within five years of implantation, from causes unrelated to the elbow arthroplasty. One patient was lost to follow-up, leaving 27 patients (35 prostheses) for review. The mean length of follow-up was 98 months (range : 60 to 174 months). At 8.2 years follow-up, the prosthesis showed a probability of survival of 76% (SD 9%) with revision of the humeral component as an end point ; the percentage dropped to 67% (SD 9%) when radiographic loosening was taken as an endpoint. Survival of the ulnar component was 98%. Loosening of the humeral component seems to be related to both the short humeral stem and a persistent extension deficit.

INTRODUCTION

Elbow involvement, present in approximately 50% of the patients with rheumatoid arthritis (12) is relatively less disabling and less frequently leads to arthroplasty than hip and knee involvement. The Souter-Strathclyde elbow prosthesis is a non-linked semicontrained resurfacing prosthesis mimicking normal anatomy (6). Stability of the prosthesis depends on intact collateral ligaments and preservation of sufficient bone stock. Reported survival rates of various elbow prostheses range from 69% to 92% at ten years (10). The purpose of this study was to investigate the medium-term survival of the Souter-Strathclyde elbow prosthesis as compared to data in the literature.

PATIENTS AND METHODS

The Souter-Strathclyde prosthesis (Stryker Howmedica Osteonics, Limerick, Ireland) is an unconstrained elbow prosthesis with humeral flanges projecting into the capitellum and the medial epicondyle (fig 1). The flanges are designed to improve the resistance to torsional and anteroposterior forces. The humeral component is made of Vitallium®, and the ulnar component is made of polyethylene. As the Souter-Strathclyde prosthesis is mostly dependent on intact collateral ligaments for stability, we used the posterolateral approach as described by Azar and Wright (1), with an incision curved to the radial side of the olecranon and making a triceps tendon flap. Peroperatively, special attention was given to the collateral ligament complexes : they were preserved inasmuch as possible, or if necessary released and carefully resutured. Postoperatively a posterior plaster of Paris slab was applied for three weeks, while rehabilitation was started immediately. The operations were

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Table I. — Table I showing a significant clinical improvement after Souter-Strathclyde total elbow arthroplasty, even after 8 years follow-up

Pain	Preoperative	1 year follow-up	8 year follow-up
None	0	31	19
Occasional twinges	0	2	2
Mild	1	1	5
Significant	15	0	7
Severe	18	0	1

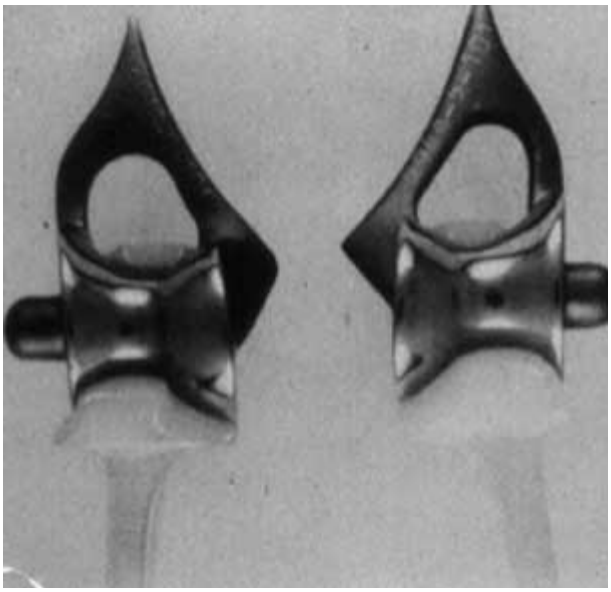

Fig. 1. — Souter-Strathclyde total elbow prostheses for right and left elbow. The prosthesis has a flat intramedullary stem for fixation in the epicondylar ridges with flanges for the capitellum and medial epicondyle of the humerus. The ulnar component has a keel and a small stem and is made of ultra-high-molecular-weight polyethylene.

performed in two hospitals by two experienced orthopaedic surgeons (AJT and ADV).

The main indication for arthroplasty was pain, while loss of function was a minor indication. All but one patient suffered from seropositive rheumatoid arthritis (RA). One patient also had haemophilia. Preoperative radiographic examination showed severe destruction of the elbow joints ; Larsen grade 4 (severe bone destruction,erosion and joint space narrowing) and grade 5 (mutilating destruction) (7). Clinical and radiological data were recorded preoperatively and postoperatively at yearly intervals. The clinical scoring system was based on the evaluation charts of Souter. Pain was graded from “none”, ”occasional twinges”, “mild”, ”significant” to ”severe” pain (table I). Radiographs obtained at the last follow-up were reviewed for signs of loosening according to the Harris radiographic loosening score**.**

From 1985 to1995, 45 Souter-Strathclyde total elbow prostheses, implanted in 36 patients with rheumatoid arthritis were prospectively followed. Eight patients (nine prostheses) died before they reached the five year follow-up. One patient was lost to follow-up, leaving 35 prostheses in 27 patients for review ; eight patients underwent bilateral surgery. Eighteen of these 27 patients were women and 9 were men. Their mean age at the time of operation was 63 years (range : 39 to 75 years). The 35 prostheses had a mean follow-up of 98 months (range 60 to 174 months) (table II).

RESULTS

Complications

Short term complications were noted in seven elbows (20%). Two patients had a transient ulnar neuropathy. One of them had a recurrent subluxation due to a mismatch of the humeral and ulnar component. The ulnar component was revised seven weeks later. Intraoperative fracture of the medial epicondyle of the humerus was encountered in two cases and was fixed with a lag screw. One fracture of the lateral epicondyle went on to nonunion and was fixed secondarily after six months with two lag screws . Hereafter consolidation was straightforward. All these complications recovered totally.

In one patient, the humeral component was erroneously rotated 180°. This prosthesis is still functioning well after nine years follow-up, with flexion to 110° and an extension deficit of 45° without pain. The radiograph shows subluxation without signs of loosening.

One patient sustained a late humeral fracture after a fall ; the prosthesis was painless until then. One patient had a fracture of the polyethylene ulnar component after eight years. He underwent a revision operation and is now painfree, with good function, with flexion to 120° and an extension deficit of 35°.

Table II. — Table II showing the study population with 6 prostheses needing revision, definite radiographic loosening in 5, probable loosening in 5, possible loosening in 2 and no loosening in 18 prostheses at follow-up

prosthesis	patient	sex	age	FU (months)	side	complications	radiographic findings
1	A	V	61	174	R		NL
2	A	V	67	102	L	neuropathy	DL
3	B	V	53	168	R	neuropathy	NL
4	B	V	55	140	L	Fracture MEC	NL
5	C	V	59	169	L		NL
6	C	V	58	108	R		revision
7	D	M	64	155	R		NL
8	E	V	39	144	L	HP	NL
9	F	V	70	128	R	Fracture LEC	PsL
10	G	V	72	119	R		DL
11	G	V	75	72	L		NL
12	F	M	58	120	R		PL
13	H	V	62	84	R		PsL
14	I	V	65	109	R		NL
15	J	M	66	60	L		DL
16	J	M	67	60	R		DL
17	K	V	56	73	L		revision
18	L	V	58	62	L		PL
19	M	V	75	119	L	Fracture MEC	NL
20	N	M	65	60	R		PL
21	O	V	58	108	R	180° false	NL
22	P	V	57	95	R		revision
23	Q	M	42	79	L		NL
24	R	V	52	71	L		revision
25	S	V	63	111	R		NL
26	S	V	66	67	L		PL
27	T	V	65	84	L		revision
28	T	V	65	87	R		NL
29	U	V	62	84	L		NL
30	U	V	62	81	R		NL
31	V	M	62	73	R	Long stem	NL
32	W	M	47	70	L		NL
33	X	M	72	61	L		NL
34	Y	V	67	90	L	Fracture UC	revision
35	Z	M	59	47	R	Loosening < 5 yrs	revision

NL : no loosening, PL : probable loosening, PsL : possible loosening , DL : definite loosening, UC : ulnar component, MEC : medial epicondyle, LEC : lateral epicondyle, HP : humeral perforation, FU : follow-up.

Clinically, patients improved dramatically especially with respect to pain. Initially (one year postoperatively) there was only one patient with mild pain ; the others had no pain or had occasional twinges. At the final follow-up 21 (62%) patients were still without any pain or had occasional twinges, five patients had mild pain, seven had significant pain and one patient had severe pain (table I).

At final follow-up the function of the operated elbows still showed significant improvement. The range of motion in terms of flexion/extension was increased by 22° and the pronation/supination range was increased by 54° (table III).

Two out of the five patients with mild pain had definite loosening, one had probable loosening, one had possible loosening and one was well fixed. Of the eight patients with significant or severe pain at follow-up, all but one had definite loosening and one had probable loosening. Loosening always concerned the humeral component except for the patient with fracture of the ulnar component (fig 2).

Overall the radiographic analysis at follow-up showed 17 prostheses without any signs of loosening (table II). There was possible loosening in two cases, probable loosening in four and eleven humeral components were definitely loose (including the revisions). No loosening of the ulnar component was noted, except for the prosthesis with the fractured ulnar component.

We carried out seven revisions for mechanical loosening of the humeral component. One revision was planned because of fracture of the polyethylene ulnar component. The revisions took place after a median time of 6.2 years (range : 3.9 to 9.0 years). Taking revision as an endpoint, the probability of survival of the prosthesis at a follow-up of 8.2 years was 76% (SD 9%) (fig 3). When definite radiographic loosening was taken as an endpoint, the probability of survival, at the same follow-up period, decreased to 68% (SD 9%).

Table III. — Table III showing preoperative average function and at an average follow-up of 98 months (8 years) a gain in flexion, pronation and supination of 22° , 24° and 30°, respectively, can be noted. Extension remained unchanged (difference in averages were determined using the paired Student t-test ; significance was set at $p < 0.05$)

Function	Pre-operative	At follow-up	p value
Extension	-38º (21°)	-40º (16°)	ns
Flexion	115º (17°)	137º (11°)	$p < 0.05$
Pronation	53º (23°)	77º (9°)	$p < 0.05$
Supination	38º (27°)	68º (22°)	$p < 0.05$

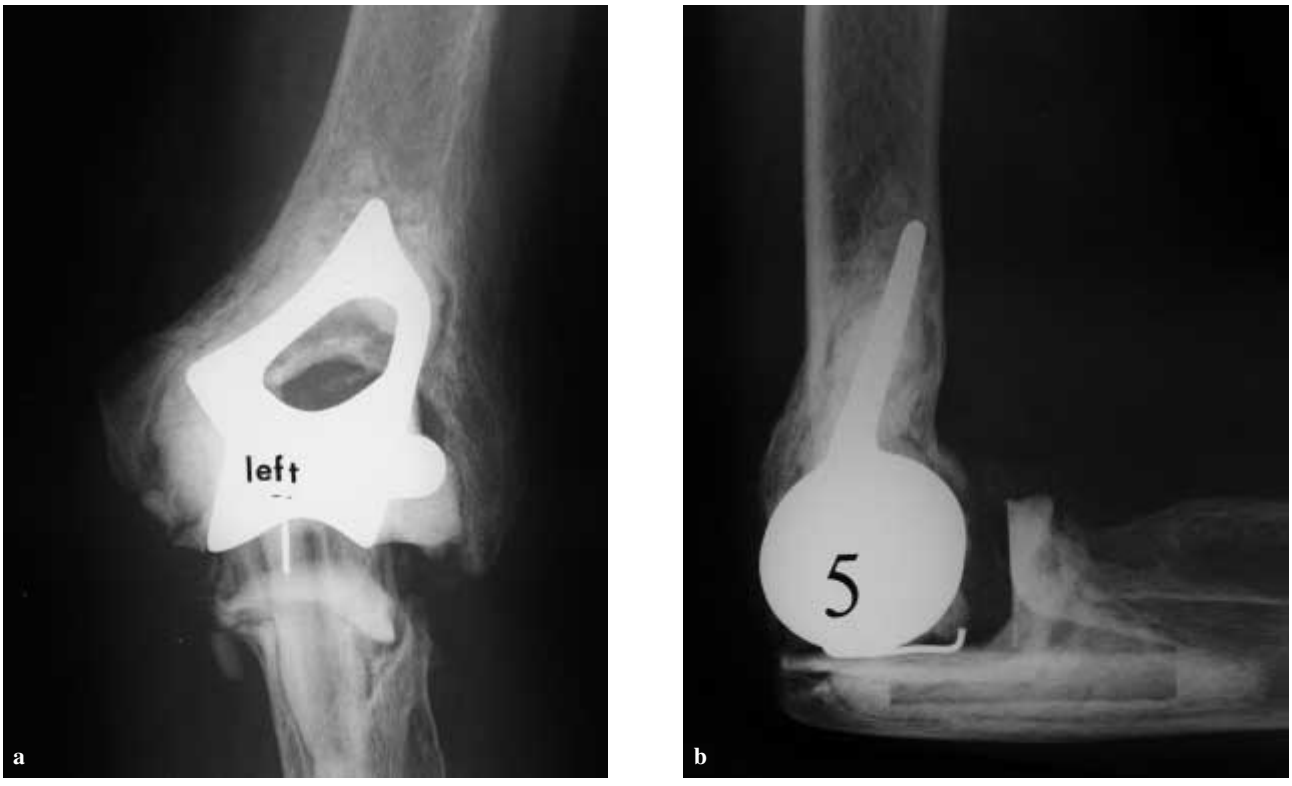

Fig. 2a, b. — Anteroposterior and lateral radiographs showing a Souter-Strathclyde elbow prosthesis 84 months after implantation in a patient with rheumatoid arthritis. Radiolucency is observed around the humeral component. Note the anterior tilt of this component which is typical of loosening.

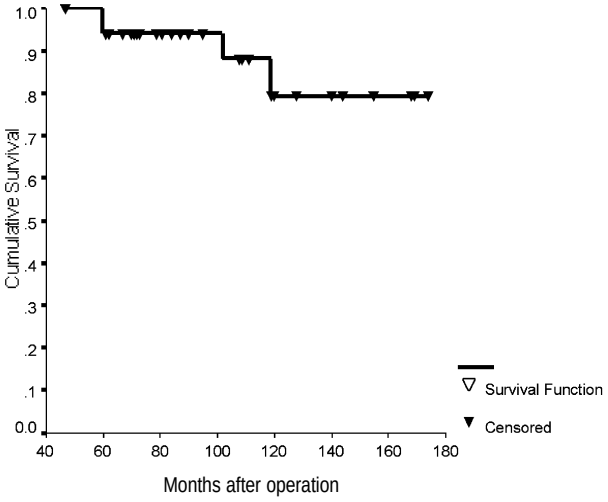

Fig. 3. — Kaplan-Meier survival curve, with revision as endpoint for 45 Souter-Strathclyde total elbow prostheses.

DISCUSSION

As the main indication for total elbow arthroplasty was pain it can be concluded that this procedure is worthwhile in rheumatoid patients. Our findings are in accordance with other studies (2, 4, 9, 12).

The overall results of elbow arthroplasty are influenced by the operative technique, the type of prosthesis used and the severity of the underlying disease (5). The posterolateral approach, as used in our series, has the theoretical advantage of giving a wide exposure of the elbow without interfering with the ligamentous structures and without jeopardising joint stability. In addition, the ulnar nerve is less at risk. However, Rozing (6) reported that, even in experienced hands, the Souter-Strathclyde elbow arthroplasty has a high complication rate with a dislocation rate of 4.5%-5%, infections (2%-4.5%), intraoperative fractures (9%) and ulnar neuropathies (1%-14%). In another medium-term follow-up study of 44 prostheses in 36 patients, no dislocations were noted, but there were 3% neuropathies, 3% infections and no fractures (2). The complication rate in our study is comparable to Rozing regarding dislocation (5.9%), intraoperative fracture (8.8%), ulnar neuropathy (5.9%) and infection. The dislocations may be related to weakening of the supporting soft tissues by the rheumatoid disease and intra-operative fractures are due to the poor bone stock in patients with rheumatoid arthritis (4, 7).

Most of the loosenings concerns the humeral component (9, 14), as was acknowledged from our series. Remarkably, in our study, loosening of the ulnar component due to fracture of the component. was seen only once. Although this is much lower than mentioned in literature, we do not have a clear explanation for this discrepancy.

Only a few long-term studies are available for comparison, in terms of radiographic and mechanical loosening. Rozing *et al* reported radiographic loosening of the prosthesis in 15% (10 out of 66) at 7.5 years follow-up. Souter reported radiographic loosening in 12% of 250 cases in a ten-year follow-up study (12). Trail *et al* published a series of 186 Souter-Strathclyde prostheses with radiographic loosening in 20% after 12 years but the standard deviation was large, and an average follow-up was not given (14). Sjöden *et al* reported a much higher percentage of loosening (6 out of 19, or 32%) of the humeral component at five years follow-up (11). In our series the rate of radiographic loosening was 34% (12 out of 35). This might be related to the more frequent use of small sized components, in an attempt to preserve as much bone stock as possible. In our experience as well as in Rozing's experience, radiographic loosening progresses very slowly. It is not known what percentage of patients will ultimately have definitive loosening (9).

Taking revision as the endpoint of survival, Trail *et al* mentioned 85% survival after 12 years (14) and Ikävalko *et al* reported a survival of 85% after 10 years (6). Rozing showed a probability of survival of 69% at ten years follow-up (9). In our study the probability of survival at eight years is 76% (SD 9%). But care must be taken when interpreting these different figures as the populations in the different studies are not similar. In the study of Ikävalko *et al*, about 30% of the subjects had an elbow arthroplasty with a longer humeral stem, which might contribute to a higher probability of survival. That a longer humeral component might contribute to a better survival has also been reported by Trail *et al* (15) : they found a higher revision rate (25 out of 32, or 78%) with the short stem

prosthesis, as opposed to the long stem (no revisions), but the follow-up period for the short stem was twice as long (4.4 years vs 9.3 years). The probability of survival of other total elbow prostheses such as the Kudo and Coonrad-Morrey prostheses are 90% at 16 years (13) and 92.4% at 10 years (3), respectively. It can be concluded that the probability of survival for the Souter-Strathclyde total elbow prosthesis is relatively lower than for those elbow prostheses, and definitely much lower than the probability of survival of a total knee or hip arthroplasty in rheumatoid arthritis (90% survival at ten years follow-up) (8).

Loosening of the humeral component followed the same pattern as described by Pöll and Rozing (1991), Sjöden *et al* (1995) and Trail *et al* (1999). The proximal end of the stem migrates ventrally into flexion pivoting around the distal part which slowly migrates to the posterior supracondylar cortex. An explanation for this loosening pattern might be given by the lack of correction of the extension deficit, which was noted in most patients at follow-up. This extension deficit increases the flexion forces to such a degree that the short stemmed humeral component is insufficient to counteract them. Complete correction of an existing extension deficit during operation and use of a long stemmed humeral component should improve the survival rate.

Radiostereometry has also showed that (rotational) instability of the humeral component might also be responsible for loosening after a two-year follow-up (16).

To conclude, this study shows that the short stemmed Souter-Strathclyde total elbow prosthesis has a probability of survival of 76% at 8 years, which is too low to advise using this prosthesis in primary elbow arthroplasty for patients with rheumatoid arthritis.

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