Revisions for aseptic loosening in Souter-Strathclyde elbow arthroplasty

Incidence of revisions of different components used in 522 consecutive cases

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ABSTRACT – We present the prosthesis survival of the 7 most commonly used component types of 522 primary Souter elbow replacements performed in the Rheumatism Foundation Hospital during the years 1982–1997. The cohort comprised 370 female and 33 male patients with a mean age of 57 (20–81) years. 119 patients had a bilateral procedure. The indications for operation in all cases were rheumatoid arthritis and other chronic inflammatory joint disease. The mean duration of the disease at the time of operation was 25 (2–70) years. Elbows were often severely destroyed and, in one third of the joints, essential bone structures were missing. Therefore, in 178 cases, the ulnar components were retentive and in the remaining 344 elbows with better bone stock non-retentive.

47 patients had 51 operations for aseptic loosening up to the end of year 2000. In the survival analysis, the general cumulative success rates for the whole study cohort, without revision because of aseptic loosening 5 and 10 years after surgery, were 96% and 84%, respectively. Revision was used as an end point. Cumulative success rates of the 7 most commonly used components are presented separately. The highest 5-year-survival rate was 100%, the lowest 93%. The corresponding 10-year-survival rates were 91% and 76%, respectively.

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Aseptic loosening is an important complication in elbow arthroplasty surgery. In some reports, loosening rates were high with hinge prostheses, but on the other hand, luxation rates could be similarly high if a hinge was avoided (Souter 1973, Morrey and Bryan 1982, Gschwend et al. 1996). Recent prosthetic designs have a floppier hinge prosthesis and some of the non-retentive models are more stable. Despite the development and choice of prosthetic designs, good surgical technique is very important (Kudo et al. 1980, Kudo and Iwano 1990, Morrey and Adams 1992, Ewald et al. 1993, Risung 1997, Gschwend et al. 1999, Shah et al. 2000). At the Rheumatism Foundation Hospital, the first arthroplasty with a Souter prosthesis was performed in 1982 (Pöll and Rozing 1991, Sjöden et al. 1988, Trail et al. 1999, Ikävalko et al. 2002). In the 1980s, the floppy hinge prosthesis (Pritchard) was also used for more severe cases. In the beginning of the 1990s, the retentive (snap-fit) Souter ulnar component was introduced and, and in an effort to avoid luxation, its use increased significantly. The nonretentive metal back ulnar component became available in 1994 and, during the 1990s, the long stem (7 cm) humeral component has been used increasingly. Some concern was expressed about the possibility that although the primary complication rate had been reduced, the long-term risk for aseptic loosening could be higher if more retentive components were used.

In this study, we analyzed the survival of the 7 most popular Souter components used in our series, including 178 cases with a retentive ulnar component.

Patients and methods

From 1982 to 1997, 522 primary total elbow replacements (TER) with the Souter-Strathclyde prosthesis were performed in 403 patients (370 women) in the Rheumatism Foundation Hospital, Heinola, Finland. 119 of them had a bilateral procedure. Their mean age at the time of surgery was 57 (20–81) years. 64 patients died during the follow-up of causes unrelated to the elbow replacement. In most patients, the indication for surgery was elbow destruction caused by rheumatoid arthritis (RA); in 480 cases, the diagnosis was rheumatoid factor-positive RA, in 15, rheumatoid factor-negative RA and in 20, juvenile chronic arthritis. 2 patients had psoriatic arthropathy. In 5 cases, the diagnosis was chronic arthritis of unknown cause. One replacement because of osteoarthrosis and two because of posttraumatic arthrosis were excluded from this sudy. The mean duration of the general disease was 25 (2–70) years before the arthroplasty, and the mean duration of the elbow symptoms 12 (2–50) years. In most elbows severe destruction was present: Larsen grade 4 in 151 joints and grade 5 in 301 joints (Larsen et al. 1977). Preoperatively, 32 fractures were present, of which 26 were located in the humerus and 6 in the ulna (Ikävalko and Lehto 2001). At the time of surgery, 86% of the patients were on continuous nonsteroid anti-inflammatory therapy, 54% received corticosteroids and 44% used disease-modifying anti-rheumatic drugs. A synovectomy had been performed on 216 elbows, with radial head excision in 57 cases and interposition arthroplasty on 50 elbows. The clinical and radiographic outcome of these patients have been reported previously (Ikävalko et al. 2002).

Surgical technique

The operations were performed by 4 orthopedic surgeons. Synovectomy was always combined with the procedure and the radial head was excised if this had not been done previously. The humeral cut and ulnar resection were usually done with a saw. The medullary cavity was reamed with a drill. The original aim when cutting the olecranon was to end up on a plane parallel to the axis of the ulna. In our material this was seldom possible because of destruction and bone loss and often only the tip of the olecranon was cut. In severe cases, especially the determination of the correct rotation was difficult and some additional correction was usually needed after a trial reposition. We have used bone cement with gentamicin since 1995 . Divided ligaments were resutured with 0-PDS through bone holes. When performing a synovectomy, the fat pad of the fossa olecrani was preserved. Thus the first layer closure before suturing of the tendon flap was possible. Suction drainage was always used. Vartious components on the humeral and ulnar sides were used, as shown in Table 1 (Figure 1).

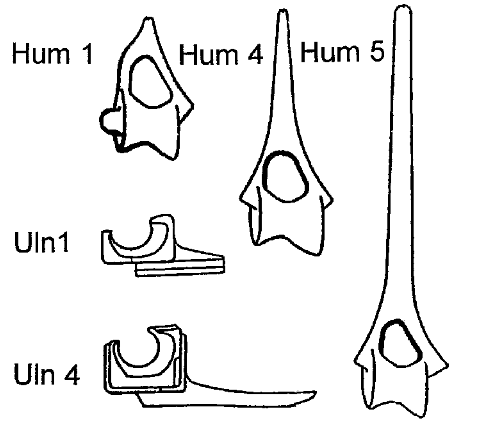

Figure 1. 5 examples of the Souter elbow prosthesis components.

Postoperative management

After operation, the patients wore a splint of plaster or glassfiber for 10–14 days before mobilization and thereafter during the night for the third week. Mobilization and functional exercises were guided by a physiotherapist.

Documentation and follow-up

The mean follow-up period was 6.6 (0–19 years; 0 refers to an early revision because of fracture and loosening) years. The minimum follow-up without revision was 3 years. At the follow-up, the clinical examinations were done with the EULAR assessment chart in use since 1986. Pre- and peroperative information was partly missing in 19 patients operated on before that, but follow-up results and complications of all these patients have been recorded. Since 1992, postoperative check-ups have been done at 3–6 months, 1 year, 4 years, 8 years, etc. The elbows were radiographed using anteroposterior and lateral views at all follow-ups, except at the first check-up. Some patients could not be examined because of their poor general condition or other severe diseases, and in those cases, radio-

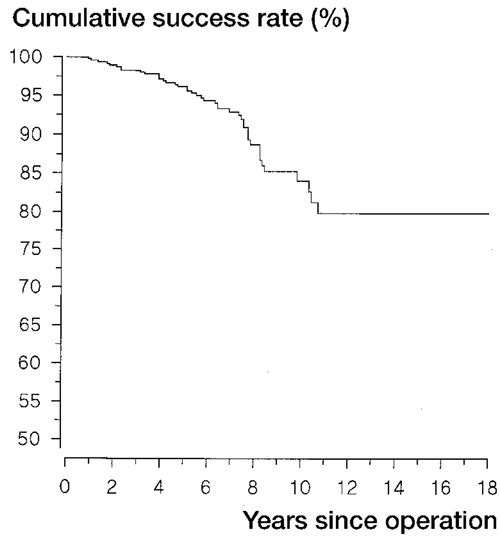

Figure 2. Cumulative success rate of the Souter elbow arthroplasty without aseptic loosening, 5 years 96% and 10 years 84 (95% CI 94–98 and 78–89, respectively)%.

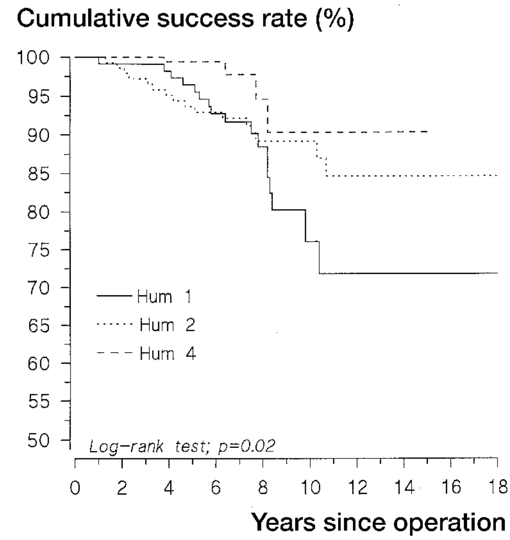

Figure 3. Cumulative success rate of 3 different humeral components. Hum 1 = small standard, 5 years 96 (91–99)%. Hum 2 = medium standard, 5 years 93 (88–97)%. Hum 4 = medium long stem (7 cm), 5 years 99 (96–100)%.

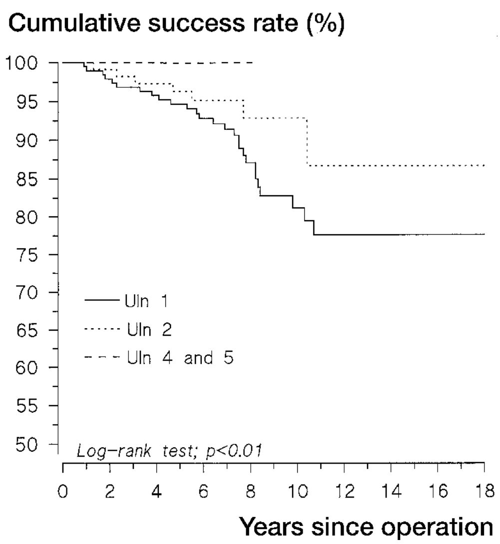

Figure 4. Cumulative success rate of 4 different ulnar components. Uln 1 = All PE small standard, 5 years 95 (90–97)%. Uln 2 = All PE medium standard, 5 years 96 (91–99)%. Uln 4 = small retentive metal back 5 cm, 5 years 100%. Uln 5 = small retentive metal back 7 cm, 5 years 100%

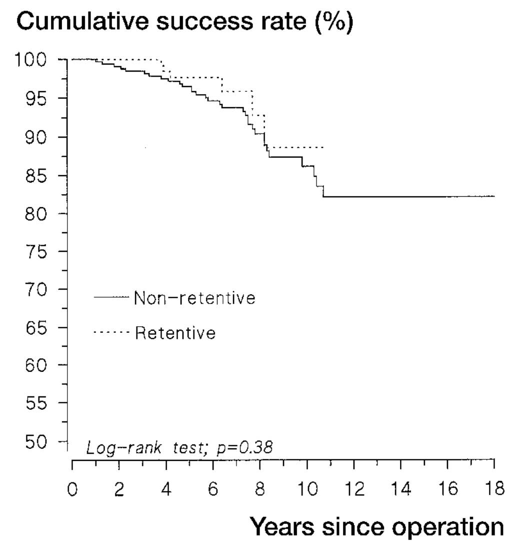

Figure 5. Cumulative success rate of humeral components without aseptic loosening having retentive ulnar components, 5 years 98 (93–99)% and having nonretentive ulnar components, 5 years 97% (94–98)%.

graphs taken in local hospitals were sent to us for evaluation. Kaplan-Meyer survivorship analysis and life tables were used to assess the overall survival rate of prostheses and evaluate their 7 most popular components separately (Figures 2–5). If only one component was removed, this revision was used as the end point for overall curves.

Table 1. Various types of prosthetic components used in the Souter elbow arthroplasty and the number of loosened components (year first time used at RFH)

	N		Loose
Humeral components			
1 Small std	119	(1982)	18
2 Med. std	151	(1982)	18
3 Large std	5	(1992)	0
4 Med. long stem, 7 cm	211	(1985)	4
5 Small long stem, 15 cm	35	(1991)	1
6 custom made	1	(1996)	0
Total	522		
Ulnar components			
1 All PE, small std	211	(1982)	31
2 All PE, med. std	119	(1982)	5
3 Metal back, nonret. stem, 5 cm	14	(1994)	0
4 Metal back, retentive stem, 5 cm	99	(1991)	0
5 Metal back, retentive stem, 7 cm	77	(1990)	0
6 Metal back, retentive stem, 9 cm	1	(1995)	0
7 Metal back, ret. custom made	1	(1996)	0
Total	522		

Table 2. Use of retentive ulnar components in consecutive primary operations

Operation ordinal	N
1– 100	3
101–200	31
201–300	31
301–400	41
401–500	57
501–525 (25)	15
Total	178

Results (Table 1)

47 of 522 patients had 51 rearthroplasties for aseptic loosening. In 10 elbows, a preoperative fracture was also present at the revision operation. Both components were changed in 30 elbows. Revision of only one component was performed on the humeral side in 11 and on the ulnar side in 6 elbows. Second revision for aseptic loosening was performed in 4 patients on the humeral side. In the survival analysis, the total cumulative success rates without aseptic loosening 5 and 10 years after surgery were 96% and 84% (95% CI 94–98 and 78–89, respectively) (Figure 2).

The success rates of the three defined humeral components are shown in Figure 3. The highest 5 (10)-year survival rates were 99% (91%) and the lowest 93% (76%). The success rates of the 4 ulnar components are given in Figure 4. The highest 5 (10)-year survival rates were 100% of ulnar components 4 and 5 (87% of ulnar component 2) and the lowest were 95% (81%).

The various success rates of humeral components with retentive or non-retentive ulnar components are shown in Figure 5.

Discussion

Our study covers a fairly long period from 1982–2000. In the beginning, only a few operations were done and experience accumulated slowly. Moreover, due to the high rate of primary complications, total elbow replacement was not a routine procedure. Therefore, most of the patients in the present series had severe elbow destruction. At first the Souter prosthesis did not offer a wide spectrum of models for different clinical conditions. The prevailing attitude was to avoid the hinge prosthesis in order to reduce the risk of aseptic loosening (Souter 1973). In retrospect, the short stem non-retentive implant was used too often in severely destroyed elbows. During the period from 1990–1992, the metal back retentive Souter ulnar component (snap-fit) became available. In the beginning, the stem length was 7 cm, and later on stem lengths of 5 and 9 cm were introduced. A nonretentive metal back component was used first in 1994. On the humeral side, only the small and medium standard models with a short stem were available first, and a so-called “revision model” having a stem length of 7 cm. In 1994, a large standard model was first used, and in 1991, a humeral component with a 15 cm stem length having 3 different types of trochlea parts also became available. In 1982–1992, the standard humeral components were used routinely. However, to avoid excessive bone resection especially on the lateral condyle side, the medium-sized long stem (7 cm) model with smaller pegs has recently become popular.

Due to the fairly high frequency of luxation in the early years (26/522 patients), we also used the retentive components as a primary solution. At the beginning of the 1990s, this model was used less frequently because it was thought to be related

Figure 6 . A moderately affected rheumatoid elbow, especially the lateral humerus condyle, has an osteopenic appearance. Preoperative state in a 37-year-old female patient.

AP and lateral views 1 year after the arthroplasty with standard components. Nearly complete thin translucencies around the humeral and ulnar components can already be seen (not visible in the early postoperative radiograph).

AP and lateral view 7 years after the arthroplasty. Wide translucencies and bone disruption are visible. Radiograph taken before the revision arthroplasty.

to a higher frequency of aseptic loosening. Use of the metal-back long stem component became commoner—not only because of its lower risk of luxation—but also because of its seeminlgy better initial fixation in patients with severe olecranon destruction. During recent years, since introduction of the non-retentive metal-back component, it has superseded the snap-fit model in elbows with sufficiently good soft tissue coverage. In our opinion, the nonretentive metal-back component is also somewhat more stable than the all-polyethylene (all-PE) component due to its higher part in the region of the coronoid process. Of the all-PE implants, the medium component seems to be more stable than the small counterpart for the same reason.

The types of patients in various countries and hospitals may differ somewhat, as also the timing of operation in different stages of arthritic joint destruction. In our material, as much as 30% of patients (156/522) had severe bone destruction with loss of essential bone structures or insufficient for the fixation of short stem standard components. In such elbows, the metal-back ulnar component offers a better option for bone transplantation than the all-PE component.

Pressurizing of the cement has not been possible so far to the same extent as in the medullary cavity of femur. A cement gun with a narrow enough syringe has not been used in the present series, but it is in use now. Bone lavage was performed with manual syringes and pressure lavage was also introduced later.

The mean follow-up times of various Souter-Strathclyde components differ, and therefore the number of cases with aseptic loosening cannot be compared in Table 1. According to component specific survival analysis the success rate of the long stem (7 cm) humeral component (Hum 4) appears to be better than with the short stem small and medium components (Hum 1 and 2) (Figure 3). However, the effect of the learning curve is obvious, because the standard components were used oftener at the beginning of this study. The medium sized standard component has been more successful than the small one. Our experience is that the bone structure is usually better for cementing in these cases when the medium size component is suitable. In very small bones, the cortex is often thinner and partly sacrificed when the condyles are reamed with a drill for the pegs of the component. On the other hand, if the component is too small for the patient, the bone structures do not give enough support for the short stem and the side pegs.

The metal back ulnar components (Uln 4 and 5) have had much better results than the all-PE components (Uln 1 and 2) (Figure 4). One can presume that an all-PE component with short stem is not an ideal solution, when the olecranon is severely destroyed, cortical bone is very thin or soft. Cement fixation easily becomes unsatisfactory and loading stress leads to initial loosening. PE -debris and micromotion of the all-PE component cause progressive loosening towards the stem more easily than with the rigid metal-back component (Figure 6).

The success rate of the humeral components when coupled with the retentive ulnar components (n 178) seems to be even higher than that with nonretentive ulnar components (n 344) (Figure 5). Again the learning curve may play an important role, but also the higher proportion of long stem humeral components with retentive ulnar components: humeral component stem 7 cm; n 117 (65%), stem 15 cm; n 35 (20%) and consequently with nonretentive ulnar components stem 7 cm; n 94 (28%). At present we have found that retentive ulnar components do not increase the loosening rate of humeral components in these couplings. However, the follow-up is still short. On the other hand, we believe that there is no indication to use only the short all-PE ulnar component in elbows with poor bone stock or in patients with a higher risk of luxation. The long stem humeral component should also be used in many primary operations.

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