The elbow

- Arthritis in the elbow is common, but rheumatic destruction of the elbow progresses slowly. Synovectomy is usually performed early, while prosthetic surgery rarely comes into question until there is loss of both cartilage and bone.
- Synovectomy seems to provide long-term pain relief and minor improvement in flexion in approximately 2/3 of the patients. Synovectomy is not followed by progressive bone loss, and hence any subsequent prosthetic surgery is not rendered more difficult.
- As the use of older, hinged prostheses ceases and the results of modern linked prostheses and surface replacement prostheses are improving, resection interposition arthroplasty will probably be retired.
- Prosthetic surgery leads to freedom from pain in 90% of the patients, but is nevertheless accompanied by a rather high risk of revision due to infection, fracture, or problems with the flexible hinge in linked prostheses. Surgery, like postoperative rehabilitation, is demanding and should therefore be consolidated to units with adequate resources to follow up patients.

The chronically inflamed elbow often causes considerable pain and loss of function in the upper extremity. Difficulty moving the hand about freely due to a painful or unstable elbow can be only poorly compensated by mobility in the shoulder and hand, the joints of which are often also involved. Long-term synovitis will eventually cause loss of cartilage and bone. Destruction of the joint surfaces often starts in the ulnohumeral (UH) joint, but arthritis in the radiohumeral (RH) joint and proximal radioulnar (PRU)joint often causes more symptoms and is responsible for impairment of rotational capacity (especially supination) in the forearm.

Arthritis in the elbow particularly impairs the ability for extension, while the ability for flexion is rarely affected until late stages. Full mobility of the forearm requires not only a healthy elbow but also a functioning wrist. In cases where rotation of the forearm is limited, the cause may be found both in the elbow and the wrist.

Instability of the elbow is unusual and generally a sign of severe arthritic changes involving bone loss.

It is not unusual that the ulnar nerve, which passes close to the articular capsule of the elbow, might be pressed by concurrent synovitis with distention of the joint. Peripheral signs of such nerve involvement is rather common.

Scope of the problem

Approximately half of all hospitalized rheumatics experience elbow problems, often at an early stage [1,13,21]. Radiologically, rheumatic destruction of the elbow progresses slowly [21]. Although pain and limitation of movement of the rheumatic elbow is a common clinical problem, surgery seldom comes into question until there is significant loss of cartilage.

In 1993, approximately 100 prosthetic operations of the elbow were performed in Sweden on the diagnosis of rheumatoid arthritis, of which the great majority were surface replacement prostheses with intramedullary stems. There is probably a sizable unmet need here since this prosthetic technique is relatively new and under development. Hence, an annual demand of approximately 200 prosthetic elbow operations can be expected.

Indications and surgical methods

The elbow joint is easy to palpate and puncture, and intra-articular cortisone usually provides reliable alleviation of synovitis. The effects on mobil-

ity and movement-related pain are obviously more limited the greater the destruction of joint surfaces. In some cases, patients experiencing instability may be helped by a stabilizing, but not mobility-impairing, orthosis.

A safe method to alleviate symptoms from the elbow in patients who are dependent on assistive walking devices (canes, crutches, walkers, etc), is to take measures in the lower extremities to make the patient independent of these devices and thereby avoid pressure on the elbow.

The stable, somewhat movable, but painful elbow is well suited for synovectomy with concurrent removal of the radial head. Synovectomy may be performed both early and late in the course, and provides good pain relief with only minor effects on mobility [13,37]. Removal of the radial head has been considered a condition for radical synovectomy, and is likely to contribute to the pain relief by disconnecting the RH and RU joints. Since the stability of the elbow is largely dependent on the congruence of the UH joint, instability problems after extirpation of the radial head are uncommon. However, synovectomy can also be performed radically with preservation of the radial head using a different surgical technique. Thus, the risk for a potential sense of weakness in the forearm, which occurs in some cases and is troublesome to the patient, may be avoided. Compression of the ulnar nerve at the elbow may, at times, also be an indication for synovectomy of the elbow, with or without concurrent neurolysis/nerve transposition.

Resection interposition arthroplasty is a method which may be considered in patients with an elbow which is painful and limited in mobility, but not too deteriorated and unstable, ie, the same group that is more often offered a prosthesis of the elbow. The procedure has previously been performed on many other indications than chronic inflammatory joint disease, and a number of interposition materials have been used over the years. The disadvantages of the method is the risk of progressive loss of bone with subsequent instability [14,23]. The affected joint surfaces are evened out and covered with a material to prevent adhesions. Usually, skin or muscle fascia from the thigh is used.

For elbows with severe mobility pain and limitation of movement, as well as pronounced loss of cartilage-bone, arthroplasty with surface replacement prostheses [7,19] or linked prostheses are now well established alternatives [10,26,29]. Development has been from hinged prostheses to prostheses with a link ("sloppy hinge"), permitting little rotation and valgus-varus laxity to decrease the forces on the bone-cement and cement-prosthesis interface, or the today more common stemmed surface replacement prostheses of the same basic type as knee prostheses.

The pain alleviating effect of prosthetic surgery is reliable and most studies report more than 90% of the patients being completely free from pain. Mobility is usually improved concerning flexion of the elbow and rotation of the forearm, while extension capacity is less affected and sometimes even somewhat worse postoperatively. However, prosthetic surgery is demanding and still associated with a relatively high frequency of complications, especially as a fortunately usually transient impairment of ulnar nerve function.

Rehabilitation

The course after a synovectomy or an interposition arthroplasty is usually uncomplicated. Mobility training can be started early and pain is no major problem. After prosthetic surgery, however, usually an initial period of immobilization in a cast is required, followed by a period with training of mobility and muscular strength with and without orthosis. Fitting of stabilizing orthosis requires substantial input from both orthopedic technicians and the patient.

Surgical treatment results

Synovectomy

There are few long-term follow-ups and it is difficult to compare different studies since the preoperative condition of the joints differ among the different studies. A further complication is that the studies use different radiographic classifications. It is also difficult to evaluate the effects of this procedure in patients also having the disease in

Table 1. Clinical results of synovectomy in the elbow

Author	No. elbows	Followup years	Pain free % "none-mild"	Gain in extension (°)	Gain in flexion (°)
Brumfield&Resnick (1985)	42	7 (2–17)	65	5	14
Saito et al. (1986)	23	4 (1–8)	74	24 *	5
Ferlic et al. (1987)	57	7 (1–20)	58	5	0
Tulp&Winia (1989)	61	7 (4–10)	63	8 (total gain)	
Makai&Chudácek (1991)	20	5 (1–15)	50	25 (total gain)	
Vahvanen et al. (1991)	70	8 (2–22)	40	–	–
Herold&Schrøder (1995)	12	14 (12–15)	71	–	20
Wanivenhaus&Bretschneider(1995)	22	4 (2–7)	64	5	21

* = in combination with soft tissue release
- = data missing

the shoulder and hand/wrist, the intensity of which may also differ preoperatively compared to postoperatively.

Table 1 shows clinical results of synovectomy in the elbow [2,9,11,27,34,37,38,39]. Of 429 operated elbows, 60 (58—74)% had no or only negligible pain from the elbow. The gain in both extension and flexion was, overall, insignificant. The gain in rotation of the forearm is not always shown, and is also of less interest, since it is dependent on the function of the wrist.

It appears that the results are not appreciably affected by the degree of preoperative destruction of the elbow [2,34,37]. One study, however, finds the best results in the least damaged elbows [9].

Some hold the opinion that synovectomy is not a temporary operation which should be performed to postpone an unavoidable prosthetic operation. On the contrary, that synovectomy is an alternative superior to prosthesis, since it is easier and less expensive to perform and has fewer complications, but still with long-term results comparable to those of prostheses [11,38]. The results concerning pain relief are, however, clearly inferior to those achieved by prosthetic surgery.

Resection interposition arthroplasty

After this procedure, pain relief has generally been reported as good [23,28,33]. The results concerning mobility and stability are however worse [23]. Complications in the form of ulnar nerve involvement and fractures are relatively common, and loss of bone may, in the long run, be such that reoperation by prosthesis is rendered impossible [23,33]. As the results of prosthetic surgery are becoming increasingly more certain, the method has slowly been forgotten. It may possibly receive renewed interest as an alternative after unsuccessful prosthetic surgery.

Prosthetic surgery

The results of hinged elbow prostheses have been disastrous, and these devices are no longer available on the market. Current devices are either prostheses where a connection between the humerus component and the ulnar component allows valgus-varus laxity and rotation, or so called surface replacement prostheses where the joint surfaces both on the humerus and ulna are replaced separately, and soft tissues are relied on for stability. The first type was used predominantly on patients with extensive bone loss. There is significant documentation on both prosthetic types in rheumatics. From 1973 to 1995 there were 40 retrospective and 2 prospective studies reporting results from 1495 elbows [19]. Direct comparisons between different studies cannot be made, since different classification systems for preoperative status were used, and data on this is sometimes lacking. Followup times vary between 1 and 10 years. On average, wound complications were reported in 9 (0–28)%, deep infection in 5 (0–16)%, and instability in 6 (0–20)%. There was ulnar nerve involvement in 16 (0–45)%. Revision frequency was 13 (0–42)%, half of the revisions were performed due to a septic prosthetic loosening.

After 1985 (hence excluding the prosthetic types no longer existing on the market), there were 18 studies published with the same prosthesis used only in rheumatics, and with more than 15 patients followed during in average at least 3

Table 2. Clinical results of prosthetic surgery in the elbow

Author	Pain free % "none–mild"	Gain in extension (°)	Gain in flexion (°)	Gain in pronation (°)	Gain in supination (°)
Weiland et al. (1989)	88 (30)[a]	3	13	15	21
Dennis et al. (1990)	90	16	17	20	12
Karanija&Stiles (1990)	75	6	8	8	4
Burnett&Fyfe (1991)	70	5	19	25	20
Hodgson et al. (1991)	–	8	16	13	14
Pöll&Rozing (1991)	96	10	21	13	11
Morrey&Adams (1992)	92	12	11	14	18
Ruth&Wilde (1992)	85	4	20	22	36
Ewald et al. (1993)	91 (26)[a]	7	17	16	19
Dhar&Beddow (1994)	93	9	17	–	–
Kudo et al. (1994)	–	3	25	7	21
Lyall et al. (1994)	89	12	24	22	27
Madsen et al. (1994)	94	21	15	22	28
Gschwend et al (1995)	98	12	16	13	12
Ljung et al. (1995)	90	10	10	10	10
Sjödén et al. (1995)	100	-2	14	15	25

[a] Ewald score at time of followup (pre-operative value in parenthesis)
– = data missing

years [3,4,6,7,10,12,15,17,18,22,24,25,26,29,31, 32,36,40]. The clinical results appear in Table 2. The number of patients with no, or insignificant, pain after prosthetic surgery was 89 (70–100)%. Pain relief in association with prosthetic surgery is thus superior to that achieved by synovectomy. It is more important to show mobility gains after surgery in the elbow than after shoulder surgery since there is no mechanism to compensate for poor mobility in the elbow as there is in the shoulder. Although the average gain in flexion was only 15° (8°–25°) it may represent a major functional gain, by the patient regaining, eg, the ability to reach his/her mouth with the hand. The gain in extension of 8° (-2°–21°) usually has little impact, while improved rotation of the forearm may be of major functional significance. How much of the improved supination of 16° (4°–28°) and pronation of 14° (8°–25°), that can be attributed to removal of the radial head, or to surgery at the wrist performed during followup is, however, not known.

For an elbow to be useful during daily activities (ADL), freedom from pain, mobility, and stability are required. Ljung et al have shown that 43/50 surface replaced elbows after 3 years showed negligible pain, a range of motion exceeding 100°, and instability less than 10° [22].

Table 3 shows complications. The predominant complication is ulnar nerve damage, which, as a rule, is reversible and which may possibly be minimized by modification of the surgical technique [20].

In the only published survivorship analysis, mechanical problems, infection, or revision, were used as end-point for an analysis of 86 linked elbow prostheses in rheumatics [16]. A 90% 5-year survival was found. For a smaller group of patients with post-traumatic arthrosis or unhealed fractures, the corresponding figure was 53%.

Ten percent of the prostheses shown in Table 3 had been revised after a mean followup time of 5 (3–10) years. The risk for aseptic prosthetic loosening is higher for linked prostheses than for surface replacement prostheses. The complications specific to the elbow consist of instability after use of surface replacement prostheses and wear of the couplings in the linked prostheses. Another specific complication is ulnar nerve damage in association with the operation. Involvement of ulnar nerve function is in average around 20% in those materials reporting this complication [19].

Characteristic to surface replacement prostheses is hence a relatively high early complication risk while the long-term risk is low. For the linked prostheses, on the contrary, the long-term results are jeopardized by both wear and mechanical prosthetic loosening. The importance of long-term follow-ups to reveal any suboptimal prosthetic designs has been emphasized by Sjödén et al. [36].

Table 3. Complications to prosthetic surgery in the elbow

Author	Number	Followup years	Prosthetic type	Wound complication (%)	Deep infection (%)	Dislocation (%)	Instability (%)	Ulnar-nerve damage (%)	Revision (%)
Ljung at al. (1989)	19	6 (5–7)	Wadsworth	26	5	0	–	16	32
Weiland et al. (1989)	39	7 (4–12)	Cap-cond	15	5	5	20	18	5
Dennis et al. (1990)	20	6 (1–11)	Cap-cond	10	5	5	20	15	5
Karanija&Stiles (1990)	40	5 (1–8)	Guildford	15	2	5	2	22	10
Burnett&Fyfe (1991)	23	3 (1–6)	Souter	–	4	9	–	17	9
Hodgson et al. (1991)	23	3 (2–5)	Cap-cond	9	0	0	–	70	0
Pöll&Rozing (1991)	34	4 (2–8)	Souter	–	3	9	6	–	15
Kudo&Iwano (1990)	37	10 (1–17)	Kudo	–	0	5	–	11	11
Morrey&Adams (1992)	68	4 (2–8)	Coonrad [a]	–	6	–	–	17	6
Ruth&Wilde (1992)	49	7 (2–13)	Cap-cond	10	8	6	–	31	14
Ewald et al. (1993)	200	6 (2–15)	Cap-cond	7	1	3	5	21	4
Dhar&Beddow (1994)	23	8 (1–16)	Liverpool	9	0	0	13	9	13
Kudo et al. (1994)	32	3 (2–4)	Kudo	–	0	0	–	0	16
Ljung et al. (1995)	50	3 (2–5)	Cap-cond	4	2	2	2	28	2
Lyall et al. (1994)	19	3 (2–5)	Souter	0	0	16	–	5	5
Madsen et al. (1994)	23	6 (4–11)	Pritchard [a]	22	4	–	44 [b]	0	30
Gschwend et al (1995)	118	4 (1–14)	GSB*	3	3	4	–	2	8
Sjödén et al. (1995)	19	5 (1–11)	Souter	–	0	5	–	16	11

[a] linked prosthesis
[b] plastic wear in the couplings with subsequent instability
– = data missing

Specific to the elbow is its superficial location, which means that wound healing complication/infection involves a significant risk of deep infection. The average risk of deep infection after an elbow prosthesis in those materials shown in Table 3, is 3% which is in the same range as the risk after a knee prosthesis, but significantly higher than the risk for infection after a hip or shoulder prosthesis. The probability that the patient will be able to keep his/her prosthesis after a synovectomy with subsequent antibiotic treatment is low. The risk of reimplantation of a new prosthesis after treatment with antibiotics is seldom taken, instead the majority of cases end with a resection arthroplasty, which generally involves significant loss of function [41].

The results after revision performed due to aseptic prosthetic loosening, instability, material defects, or fracture are significantly better [5,8].

References

1. Amis AA, Hughes SJ, Miller JH, Wright V. A functional study of the rheumatoid elbow. Rheumatol Rehabil 1982; 21: 151-7.
2. Brumfield RH, Resnick CT. Synovectomy of the elbow in rheumatoid arthritis. J Bone Joint Surg 1985; 67-A: 16-20.
3. Burnett R, Fyfe IS. Souter-Strathclyde arthroplasty of the rheumatoid elbow. 23 cases followed for 3 years. Acta Orthop Scand 1991; 62: 52-4.
4. Dennis DA, Clayton ML, Ferlic DC, Stringer EA, Bramlett KW. Capitello-condylar total elbow arthroplasty for rheumatoid arthritis. J Arthroplasty 1990; 5: 183-8.
5. Dent CM, Hoy G, Stanley JK. Revision of failed total elbow arthroplasty. J Bone Joint Surg 1995; 77-B: 691-5.
6. Dhar S, Beddow FH. The modified Liverpool total elbow prosthesis. J Hand Surg (Br) 1994; 19: 224-8.
7. Ewald FC, Simmons ED, Sullivan JA, Thomas WH, Scott RD, et al. Capitellocondylar total elbow replacement in rheumatoid arthritis. Long-term results. J Bone Joint Surg 1993; 75-A: 498-507.
8. Ferlic DC, Clayton ML. Salvage of failed total elbow arthroplasty. J Shoulder Elbow Surg 1995; 4: 290-7.
9. Ferlic DC, Patchett CE, Clayton ML, Freeman AC. Elbow synovectomy in rheumatoid arthritis. Clin Orthop 1987; 220: 119-25.
10. Gschwend N, Scheier H, Bähler A, Simmen B. GSB III Elbow. In: The elbow. Endoprosthetic replacement and non-endoprosthetic procedures (Ed. Rüther W). Berlin: Springer Verlag, 1995; 83-98.
11. Herold N, Schrøder HA. Synovectomy and radial head excision in rheumatoid arthritis. Acta Orthop Scand 1995; 66: 252-4.

12. Hodgson SP, Parkinson RW, Noble J. Capitellocondylar total elbow replacement for rheumatoid arthritis. J R Coll Surg Edinb 1991; 36: 133-5.
13. Hämälainen M. Epidemiology of upper limb joint affections in rheumatoid arthritis. In: Rheumatoid arthritis, Current trends in diagnostics, conservative treatment, and surgical reconstruction (Eds. Baumgartner H, Dvorak J, Grob D, Munzinger U, Simmen BR). Stuttgart: George Thieme Verlag, 1995; 158-61.
14. Hämälainen M, Hagena FW. Late radiographic results after resection skin interposition arthroplasty in the elbow in rheumatoid arthriotis. Rheumatology 1991; 15: 42-6.
15. Karanija ND, Stiles PJ. The Guildford elbow. Int Orthop 1990; 14: 315-9.
16. Kraay MJ, Figgie M, Inglis AE, Wolfe SW, Ranawat CS. Primary semi-constrained total elbow arthroplasty. Survival analysis of 113 consecutive cases. J Bone Joint Surg 1994; 76-B: 636-40.
17. Kudo H, Iwano K. Total elbow arthroplasty with a nonconstrained surface relacementy prosthesis in patients who have rheumatoid arthritis. A long-term follow-up study. J Bone Joint Surg 1990; 72-A: 355-62.
18. Kudo H, Iwano K, Nishino J. Cementless or hybrid total elbow arthroplasty with titanium-alloy implants. A study of interim clinical results and specific complications. J Arthroplasty 1994; 9: 269-78.
19. Ljung P. Arthroplasty of the rheumatoid elbow. With special reference to non-constrained replacement and its complications. Thesis, University of Lund, 1995.
20. Ljung P, Ahlmann S, Knutson K, Rosén I, Rydholm U. Intraoperative monitoring of ulnar nerve function during replacement of the rheumatoid elbow via the lateral approach. Acta Orthop Scand 1995; 66: 132-6.
21. Ljung P, Jonsson K, Rydgren L, Rydholm U. The natural course of rheumatoid elbow arthritis: a radiographic and clinical 5-year follow-up. J Orthop Rheumatol 1995; 8: 32-6.
22. Ljung P, Jonsson K, Rydholm U. Short-term complications of the lateral approach for non-constrained elbow replacement. J Bone Joint Surg 1995; 77-B: 937-42.
23. Ljung P, Jonsson K, Larsson K, Rydholm U. Interposition arthroplasty of the elbow with rheumatoid arthritis. J Shoulder Elbow Surg 1996; 5(2Pt1): 81-5.
24. Ljung P, Lidgren L, Rydholm U. Failure of the Wadsworth elbow. Nineteen cases of rheumatoid arthritis followed for 5 years. Acta Orthop Scand 1989; 60: 254-7.
25. Lyall HA, Cohen B, Clatworthy M, Constant CR. Results of the Souter-Strathclyde total elbow arthroplasty in patients with rheumatoid arthritis. J Arthroplasty 1994; 9: 279-84.
26. Madsen F, Søjbjerg JO, Sneppen O. Late complications with the Pritchard Mark II elbow prosthesis. J Shoulder Elbow Surg 1994; 3: 17-23.
27. Makai F, Chudácek J. Long-term results of synovectomy of the elbow with excision of the radial head in rheumatoid arthritis. Rheumatology 1991; 15: 22-6.
28. Milbrink J, Wigren A. Resection interposition arthroplasty of the elbow in rheumatoid arthritis. J Orthop Rheumatol 1990; 3: 95-106.
29. Morrey BF, Adams RA. Semi-constrained arthroplasty for the treatment of rheumatoid arthritis of the elbow. J Bone Joint Surg 1992; 74-A: 479-90.
30. Porter BB, Richardson C, Vainio K. Rheumatoid arthritis of the elbow: The results of synovectomy. J Bone Joint Surg 1974; 56-B: 427-37.
31. Pöll RG, Rozing PM. Use of the Souter-Strathclyde total elbow prosthesis in patients who have rheumatoid arthritis. J Bone Joint Surg 1991; 73-A: 1227-33.
32. Ruth JT, Wilde AH. Capitello-condylar total elbow replacement. A long-term follow-up study. J Bone Joint Surg 1992; 74-A: 95-100.
33. Rüther W, Tillman K. Resection interposition arthroplasty of the elbow in rheumatoid arthritis. In: The elbow. Endoprosthetic replacement and non-endoprosthetic procedures (Ed. Rüther W). Berlin: Springer Verlag, 1995; 57-67.
34. Saito T, Koshino T, Okamoto R, Horiuchi S. Radical synovectomy with muscle release for the rheumatoid elbow. Acta Orthop Scand 1986; 57: 71-3.
35. Simmen BR, Gschwend N. Elbow arthroplasty – Cinderella of arthroplasty: reconstruction of the elbow with the GSB III elbow prosthesis. In: Rheumatoid arthritis. Current trends in diagnostics, conservative treatment, and surgical reconstruction (Eds. Baumgartner H, Dvorak J, Grob D, Munzinger U, Simmen BR). Stuttgart: George Thieme Verlag, 1995; 198-212.
36. Sjödén GOJ, Lundberg A, Blomgren GA. Late results of the Souter-Strathclyde total elbow prosthesis in rheumatoid arthritis. Acta Orthop Scand 1995; 66: 391-4.
37. Tulp NJA, Winia WPCA. Synovectomy of the elbow in rheumatoid arthritis. Long-term results. J Bone Joint Surg 1989; 71-B: 664-6.
38. Vahvanen V, Eskola A, Peltonen J. Results of elbow synovectomy in rheumatoid arthritris. Arch Orthop Trauma Surg 1991; 110: 151-4.
39. Wanivenhaus A, Bretschneider W. Late synovectomy of the elbow joint. In: Rüther W, ed. The elbow: Endoprosthetic replacement and non-endoprosthetic procedures. Berlin: Springer Verlag, 1995: 48-56.
40. Weiland AJ, Weiss AC, Wills RP, Moore JR. Capitellocondylar total elbow replacement. A long-term follow-up study. J Bone Joint Surg 1989; 71-A: 217-22.
41. Wolfe SW, Figgie MP, Inglis AE, Bohn WW, Ranawat CS. Management of infection about total elbow prostheses. J Bone Joint Surg 1990; 72-A: 198-211.