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ARTHROPLASTY OF THE ELBOW USING J-K MEMBRANE

An Analysis of 31 Cases

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A study of the end results of arthroplasty of the elbow has been made; 31 cases were evaluated clinically and roentgenographically an average of 19 years after operation. The arthroplasty was performed with a minimum of bone resection using chromicized fascia lata (J-K membrane) as an interposition. The maximum range of motion was regained within 3 months and was maintained during the follow-up period. No patient in this series suffered from pain or instability of the joint though radiological signs of osteoarthritis were common.

Key words: arthroplasty of the elbow; J-K membrane

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Restriction of movement and pain in the elbow joint are a cause of disability at work and limitation of daily activity. Arthrodesis is unsatisfactory from the functional and cosmetic points of view.

Various arthroplastic procedures have been devised in an attempt to improve these conditions, since the first success of Verneuil (1860), and the subsequent description of the principles of arthroplasty by Ollier (1885), Murphy (1913), and Campbell (1931). Due to the rapid development of the various types of endoprostheses, classical methods of arthroplasty have been abandoned in recent years. Nevertheless, the elbow still remains the joint most suited for arthroplasty without a prosthesis, because it bears little weight and the pattern of movement is relatively simple.

In Japan, Sumita (1912) carried out experimental studies on arthroplasty and Jinnaka & Kono (1949) utilized chromicized autogenous fascia (named J-K membrane) as an interposition. They succeeded in diminishing the inflammatory tissue reaction of Baer's membrane (1918) by reduction of the dichromic acid potassium under direct sunlight and washing off of the soluble chromic oxidase.

The purpose of the present analysis is to evaluate the long-term results as regards 1) range of motion 2) functional ability 3) severity of neurological complications and 4) roentgenographic changes, in a series of this type of arthroplasty.

PATIENTS AND METHODS

Details of the 31 patients in this series are listed in Table 1. There were eight cases of septic arthritis, fifteen cases of fracture or fracture-dislocation and seven cases of rheumatoid arthritis.

1) *Preparation of J-K membrane*

One week before operation, a sheet of fascia, 8 × 6 cm, is detached from the tensor fascia lata

Table 1. Pre- and postoperative data of the 31 patients.

Case	Age	Side	Etiology and duration of ankylosis (years)		Range of motion (extension–flexion) Initial	3 months after operation	At the time of follow-up	Evaluation	Length of follow-up (years)
1	15	r	Fracture	7	50	30–105	30–105	Good	5
2	19	r	Tuberculous	17	65	45– 87	60	Poor	17
3	36	l	Fracture	5	70	50–115	50–135	Good	16
4	25	r	R.A.	8	90	35–165	15–145	Excellent	7
5		l			80	30–160	20–140	Excellent	7
6	24	r	Dislocation	11	50	50–100	60– 95	Poor	23
7	50	r	Fracture	2 months	55–80	50–100	20–115	Excellent	21
8	25	r	R.A.	4	10–50	30–115	60	Poor	20
9	50	r	Typhoid	20	45–70	60– 70	70	Poor	10
10	23	r	Tuberculous	10	80	65–110	65–110	Fair	22
11	20	r	Fracture	15	40–90	35–105	50– 90	Fair	22
12	22	r	Osteomyelitis	11	5	35– 80	40–120	Good	24
13	40	l	Gonococcal	25	30	25– 85	30– 90	Fair	18
14	29	r	Dislocation	1	65–70	65–100	55–115	Fair	30
15	32	r	Fracture	11	45–65	60–100	50– 90	Fair	24
16	40	r	Purulent	22	40	50–100	55–110	Fair	27
17	19	r	Purulent	8	90	65– 82	85	Poor	25
18	42	l	Fracture	4 months	87	30–130	20–110	Excellent	28
19	41	r	Gonococcal	10	45	25– 50	35– 50	Poor	28
20	15	l	Fracture	5	50–70	20–110	60–115	Fair	30
21	33	r	Fracture	2	50	35–100	30–110	Good	31
22	22	r	R.A.	8	60	35–110	20–110	Excellent	9
23		l		7	55	35–120	30–120	Excellent	9
24	24	r	R.A.	5	50–60	35– 95	30–100	Fair	10
25	32	r	Dislocation	3	20	40– 70	15– 90	Good	11
26	34	r	Dislocation	3	20	20– 90	20–125	Excellent	9
27	32	r	R.A.	5	30	30–120	30–120	Excellent	9
28	15	l	Fracture	5	40–80	50–100	40–110	Good	25
29	18	r	Fracture	4	65	65– 90	60–100	Fair	26
30	12	r	Fracture	4	50	60– 75	60–100	Fair	23
31	20	r	Osteochondromatosis	3	20–85	50–130	40–130	Excellent	22
Average	27			8	50–59	42–102	43–105		19

muscle of the patient. The fascia is stretched on a frame and kept in a 2 per cent dichromic acid potassium solution at room temperature for 24 hours. Following this, it is exposed to direct sunlight or a quartz lamp for 1 or 2 days in order to reduce the dichromic acid. The fascia is then washed in running water for 24 hours. Afterwards it is stored in phenol with the addition of 70 per cent alcohol.

2) *Operative technique*

A posterior approach is preferred. The olecranon is cut and reflected. A simple monocondylar joint is fashioned by resection of a minimum amount of bone in order to avoid postoperative instability. The humero-ulnar joint is reshaped according to the anatomical curvature. The radial head is usually resected at the same level as the ulna. In nine cases, reshaping of the radial head was done in order to preserve the pronation-supination of the forearm. In four cases, transposition of the ulnar nerve was performed.

The coronoideal and olecranon fossae are deepened and the end of the humerus is covered by the J-K membrane. Lengthening of the triceps tendon is rarely necessary, even when the elbow is ankylosed in full extension.

3) *Aftertreatment*

The extremity is immobilized for 1 week, following which an extension frame is applied (Figure 1). Three weeks after operation, pulley exercises are begun in the frame with mild resistance both active and passive.

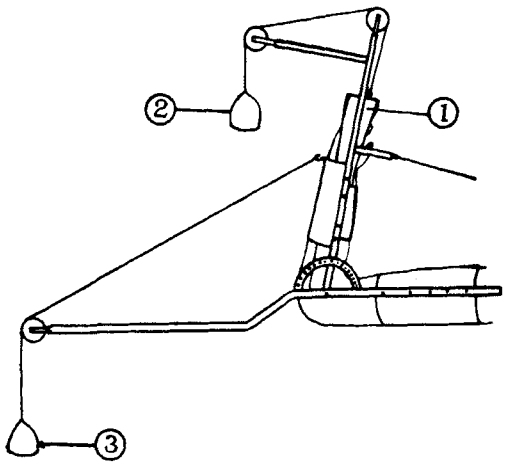

Figure 1. Traction-pulley exercise apparatus.
1: Skin traction on forearm.
2: Weight for traction of forearm.
3: Weight for flexion exercises of the elbow.

RESULTS

The end results have been graded as follows:

Excellent: range of motion from 90 to 120°, with good stability and muscle strength.

Good: range of motion from 70 to 90°, with satisfactory stability and sufficient strength for everyday activities.

Fair: range of motion from 40 to 70°, without instability, or adequate range of motion with instability.

Poor: range of motion less than 40°, and/or gross instability.

The results classified according to the various etiologies are shown in Table 2.

In 15 cases of fracture and fracture-dislocation, one failure was due to postoperative infection. The results were very diverse in this group, perhaps because the deformity of the humeral condyle makes it difficult to judge the optimal amount of bone resection. Soft tissue damage following open fracture is also an undesirable factor.

The results in eight cases of septic arthritis were almost entirely unsatisfactory. Only one case was evaluated as good.

Among seven cases of rheumatoid arthritis, one failure was due to fracture of the humerus 5 months after the operation (Case 8). The elbow was immobilized for 2 months as a consequence of which bony ankylosis developed. Apart from this case, the results for this condition are most encouraging in spite of extensive joint involvement (Figure 2). The disease was quiescent at the time of operation and no exacerbation of the arthritic process followed. Arthroplasty of both elbows was performed in two patients and the results were satisfactory. Less resorption of bone was found in the rheumatoid cases in comparison to the other groups. In general, rheumatoid arthritis was considered to be the best in-

Table 2. The results of arthroplasty of the elbow classified according to the various etiologies.

Etiology	Excellent	Good	Fair	Poor	No. of cases
Fracture and/or dislocation	3	5	6	1	15
Septic arthritis		1	3	4	8
Rheumatoid arthritis	5		1	1 *	7
Osteochondromatosis	1				1
Total	9	6	10	6	31

* Case 8.

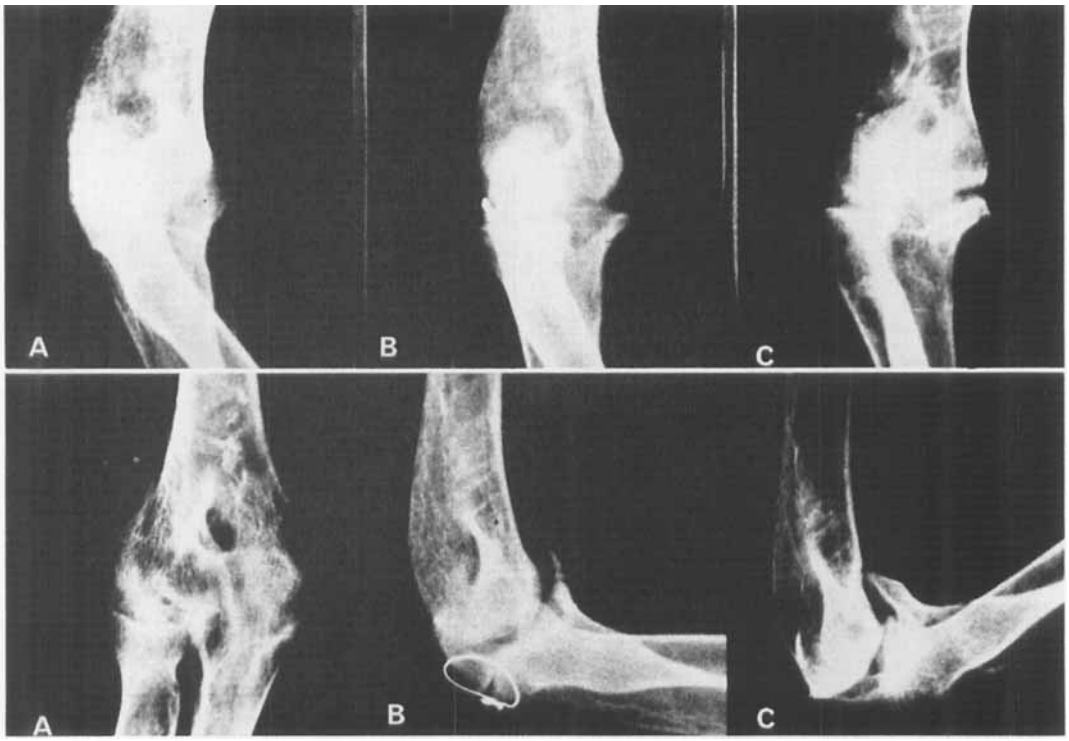

Figure 2. Case 27. Rheumatoid arthritis. a) before, b) 2 months and c) 9 years after operation.

dication for this type of arthroplasty (Herbert 1958, Hurri et al. 1964).

As a general rule, the maximum range of motion was regained within 3 months after the operation and this remained unchanged as time passed. Bone resorption was rarely seen in our patients. Proliferative or hypertrophic bone changes were found quite frequently, but never to such an extent that pain or progressive limitation of motion could be attributed to them. There were no cases of serious instability or subluxation. Pseudoarthrosis of the olecranon was found in four cases, but the force of extension was not diminished.

Air arthrography was performed in four cases. The joint cavity had almost normal dimensions (17.5 ml on average) and was bounded by an irregular capsule

(Figure 3). It was not possible to deduce the exact thickness of the articular cartilage. No dispersion of the air to the radioulnar joint was seen.

The roentgenographic changes following arthroplasty do not parallel the functional result. However, the irregularity of the joint surfaces, the hypertrophic changes and incongruity of the joint do not cause pain. In fact, no patient in this series has suffered from pain in carrying out daily activities.

Ulnar nerve palsy and other neurological disturbances were not found.

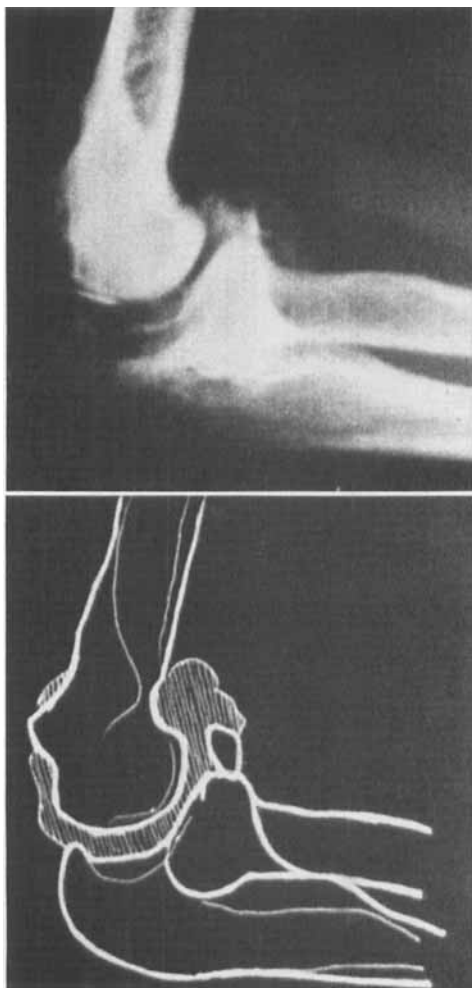

Figure 3. Air arthrography of Case 26.

DISCUSSION

It appears from our series of patients that the mobility of the elbow remains unchanged in spite of gross roentgenographic changes. However, cases with an infectious origin lead to very poor functional results. If this procedure is selected, the surgeon should be certain that the inflammatory process has completely subsided. In general it may be stated that previous infection is a contraindication, even though the means available for antibiotic treatment are far better today than they were 30 years ago (Campbell 1922, 1924, Phemister & Miller 1924).

It seems that muscle weakness due to long-term loss of mobility is not always irreversible if adequate and sustained muscle training is instituted before and after operation.

The best indication for the arthroplasty is functional disability due to rheumatoid arthritis, because in these cases the anatomical shape of the condyle is often preserved. If, on the other hand, excessive bone atrophy is present, the procedure is contraindicated.

The amount of bone resection should be determined with the aim of obtaining a balance between good mobility and preservation of a stable joint. The range of motion in this series was not always satisfactory because of a reluctance to remove too much of the end of the humerus, when compared with the procedures of Hass (1944), D'Aubigné & Kerboul (1966) and Hurri et al. (1964). This may explain why serious instability due to excessive condylar resorption was not found. We do agree with Knight & van Zandt (1952) who recommended a gap after bone resection of three-quarters of an inch. Excessive resection of the radial head should also be avoided. In our series, reshaping instead of resection of the radial head and interposition of the J-K membrane in the proximal radio-

ulnar joint were performed in nine cases with the result that a rotational movement of more than one half of the normal range was obtained in six cases.

The advantage of the J–K membrane is that apparently it produces less adhesions in the newly established joint compared with the other kinds of interposition (Putti 1920, McAusland 1921, Nagayama et al. 1971), and also it permits a minimal amount of bone resection.

In our opinion this classical arthroplasty of the elbow is well worth trying because it results in a stable joint with a useful range of mobility and freedom from pain. Endoprosthesis should be reserved for the rare cases with pronounced bone destruction and very unstable joints.

It can be concluded that arthroplasty of the elbow using J–K membrane, properly performed in selected cases, offers a useful range of motion with good stability and strength. It is indicated for patients between 15 and 60 years of age, when functional disability is the result of rheumatoid arthritis and fracture or fracture-dislocation of the elbow joint.

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REFERENCES

Baer, W. S. (1918) Arthroplasty with the aid of animal membrane. *Amer. J. orthop. Surg.* **16**, 171–199.

Campbell, W. C. (1922) Arthroplasty of the elbow. *Ann. Surg.* **76**, 615–623.

Campbell, W. C. (1931) The physiology of arthroplasty. *J. Bone Jt Surg.* **13**, 223–245.

Campbell, W. C. (1924) Mobilization of joint with bony ankylosis. *J. Amer. med. Ass.* **27**, 976–981.

D'Aubigné, R. M. & Kerboul, M. (1966) Les opérations mobilisatrices des raideurs et ankyloses du coude. *Rev. Chir. orthop.* **52**, 427–448.

Hass, J. (1944) Functional arthroplasty of elbow and knee. The American Academy of Orthopaedic Surgeons Instructional Course Lectures, Vol. 2, p. 340.

Herbert, J. J. (1958) Traitement des ankyloses du coude dans le rhumatisme. *Rev. Chir. orthop.* **44**, 87–90.

Hurri, L., Pulkki, T. & Vainio, K. (1964) Arthroplasty of the elbow in rheumatoid arthritis. *Acta chir. scand.* **127**, 459–465.

Jinnaka, S. & Kono, S. (1949) *The arthroplasty* (Japanese). Tokyo, Igakushoin.

Knight, R. A. & van Zandt, I. L. (1952) Arthroplasty of the elbow. *J. Bone Jt Surg.* **34**-A, 610–618.

Ollier, L. (1885) *Traité des résection et des opérations conservatives qu'on peut pratiquer sur le système osseux.* G. Masson, Paris.

MacAusland, W. R. (1921) Mobilization of the elbow by fascia transplantation with report of thirty-one cases. *Surg. Gynec. Obstet.* **33**, 223–245.

Murphy, J. B. (1913) Arthroplasty. *Ann. Surg.* **57**, 593.

Nagayama, I., Tsuge, K., Mochizuki, Y. & Nakamura, Y. (1971) On the experience of arthroplasty of the elbow (Japanese). *Orthop. Surg.* **22**, 1110–1117.

Phemister, D. B. & Miller, E. M. (1924) The method of new joint formation in arthroplasty. *Surg. Gynec. Obstet.* **26**, 406–446.

Putti, V. (1920) Arthroplasty of the knee joint. *J. orthop. Surg.* **2**, 530.

Sumita, M. (1912) Experimentelle Beiträge zur operativen Mobilisierung ankylosierter Gelenke. *Arch. klin. Chir.* **99**, 755.

Verneuil, A. (1860) De la creation d'une fausse articulation par section ou résection partielle de l'os maxillaire inferieur, comme moyen de remedier l'ankylose orale du fausse de la mâchoire inferieur. *Arch. gén. Méd.* **15**, 284–316.

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