Elbow interposition arthroplasty in children and adolescents: long-term follow-up

Federico Fernandez-Palazzi · Janeth Rodriguez ·
Guillermo Oliver

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Abstract A long-term follow-up was made of 12 elbows operated upon between 1971 and 1986, with more than 20 years' follow-up, in nine males and three females, age at the time of surgery between 10 and 19 years. Eight right and four left elbows were involved, and there were three aetiological causes. Seven cases were sequelae of elbow fractures, of which five were supracondylar and two were of the olecranon. There were four cases of juvenile rheumatoid arthritis and one was post-osteomyelitis. The surgical technique involved a modification made by Vainio of MacAusland's technique (wider resection of the osseous ends and total covering of the bloody surfaces) [5, 9]. After extirpating the tissue blocking the joint, we proceeded to remodel the distal humerus in a wide V shape, the proximal end of the ulnar and, if necessary, the radial head. The proximal end of the ulna was sectioned transversely. All surgery was carried out sub-periosteally. Then, an interposition material was placed in one piece and sutured over the distal humerus and cut ends of the ulna and radius. The articular ends were brought together, and the capsule was closed using equidistant stitching, as is the skin. A small compression bandage was applied, and the arm was immobilised with a collar and cuff sling, with the forearm flexed to slightly less than a right angle. In ten cases, the interposition material was fascia lata grafts; in one case, skin graft and in one case, Gelfoam graft. Early rehabilitation began when post-operative pain allowed.

Follow-up ranged from 25 to 32 years. Pre-surgical movement ranged between 90° and 120° of flexion and 30° and 90° of extension. Post-operative range varied between 90° and 150° of flexion. The five cases of full pre-operative ankylosis achieved between 90° and 150° of flexion and between 0° and 70° of extension. The total range of motion at the latest follow-up varied from 35° to 150°. Patients who were able to perform flexion of 120° or more were considered to be excellent, those between 90° and 119° were graded good, from 60° to 89° fair and those 59° or less poor. The ability to attain a hand to mouth position requires a mobility of 120°. We obtained excellent results in two patients, good results in three, fair results in four and poor results in three. The fascia lata was used in 83% of cases, obtaining excellent to good results in five patients (41%). Elbow interposition arthroplasty has its indications in children and adolescents where arthrodesis or total joint replacement cannot be performed.

Résumé Un suivi à long-terme a été réalisé sur 12 coudes raides opérés entre 1971 et 1986 sur un suivi de plus de 20 ans, il s'agissait de 9 garçons et de 3 filles, l'âge au moment de la chirurgie était compris entre 10 et 19 ans, il s'agissait de 8 coudes droits et de 4 coudes gauches. 7 coudes présentaient une séquelle de fracture, 5 supra condyliennes et 2 de l'Olécrane, 4 coudes relevaient d'une pathologie inflammatoire arthrite rhumatoïde juvénile et 1 coude d'une ostéomyélite. Nous avons utilisé une modification de la technique de Vainio et Mac Ausland [5] avec une résection osseuse large et une résection arthroplastie non prothétique. Après résection du tissu fibreux, nous avons remodelé l'extrémité distale de l'humérus, réalisant un large V, nous avons également remodelé, si cela était nécessaire le cubitus et la tête radiale. La partie proximale du cubitus a été ostéotomisée transversalement. Tous ces gestes ont été

F. Fernandez-Palazzi (✉) · J. Rodriguez
Pediatric and Neuro-orthopedic Unit, Centro Médico de Caracas,
Edif. Anexo B. Cons 4CAv. Juan de Villegas, San Bernardino,
Caracas 1011, Venezuela
e-mail: feferpal@telcel.net.ve

G. Oliver
Paediatric Orthopaedics,
Policlinica La Arboleda,
Caracas c10011, Venezuela

réalisés en sous périoste. Une arthroplastie par interposition a ensuite été réalisée de façon à recouvrir la partie distale de l'humérus et les surfaces cruentées du cubitus et du radius, la capsule et la peau étant ensuite fermées. Un petit bandage compressif a été réalisé, le coude immobilisé par un bandage en écharpe à 90°. L'interposition de matériel a été dans 10 cas du fascia lata, dans un cas de la peau et dans un cas une greffe de type gelfoam. La rééducation a été débutée très rapidement en post opératoire. Le suivi a été réalisé sur une période de 25 à 32 ans. La mobilité préopératoire des coudes était de 90 à 120° en flexion et de 30 à 90° en extension. En post opératoire, la mobilité a varié de 150 à 90° en flexion. Les 5 cas d'ankylose préopératoire complète ont récupéré une mobilité de 90 à 150° en flexion et de 0 à 70° en extension. La mobilité totale du coude au dernier suivi variait de 35 à 150°. Les patients capables d'avoir une flexion du coude à 120° ou plus ont été considérés comme excellents, ceux dont la flexion oscillait entre 90 et 119° ont été cotés comme bons entre 60 et 89° comme moyen et, en dessous de 59° comme mauvais. La possibilité de mettre la main à la bouche nécessite une mobilité d'au moins 120°. Le résultat a été coté comme excellent chez 2 patients, bon chez 3 patients, moyen chez 4 et mauvais chez 3. Le fascia lata a été utilisé dans 83% des cas dont 5 patients ayant obtenu un bon et un excellent résultat (41%). La résection arthroplastie du coude avec interposition de fascia lata a des indications chez l'enfant et chez l'adolescent, notamment lorsqu'une arthrodèse ne peut être réalisée.

Introduction

A mobile elbow joint is necessary in order to have useful upper limb function to use the hand. If this joint is fused, as occurs in juvenile rheumatoid arthritis or after elbow fractures, or if it is painful, its normal functioning is inhibited. This rigidity in adults can be solved with a total joint

Fig. 1 Preparation of the interposition material

Fig. 2 Interposition fascia lata around the humeral edge

arthroplasty, but this procedure should be avoided in the growing child who sustains trauma or lesions resulting in a functional incapacity leading to failure in the long term. It is desirable that the range of motion at the elbow level be reasonably wide, as a serious limitation of movement will prevent the individual performing some necessary every-day activities, such as feeding, combing hair, etc. The ranges of mobility of the elbow require four movements: flexion, extension, pronation and supination. Normal flexion goes as far as 150°, and pronation is more important than supination. When the elbow is stiff, we must attempt to attain useful flexion, extension and stability to avoid difficulty in use and mobility. In adults, these goals can be obtained by means of a total joint replacement [1, 2, 8]. On the other hand, very little has recently been published in relation to elbow arthroplasties in the growing child [4, 7, 10]. We had the opportunity to follow-up for a reasonable period 12 cases treated by our team, which are reported here.

Materials and methods

This study included a representative sample of patients operated upon between 1971 to 1986 with more than

Fig. 3 Manipulation under anaesthesia

Table 1 Patient characteristics, surgical techniques and functional results

Case	Gender	Aetiology	Side	Material	Age (years)	F U	ROM ext. (°)	ROM flex. (°)	Total ROM (°)
1	F	SF	L	FL	13	21	Pre 90 post 20	Pre 120 post 100	90
2	M	JRA	L	S	15	18	Pre 35 post 120	Pre 120 post 120	85
3	M	SF	R	FL	19	32	Pre 90 post 155	Pre 90 post 90	75
4	M	JRA	L	FL	10	23	Pre 0 post 10	Pre 190 post 140	130
5	M	SF	L	GF	14	14	Pre 90 post 60	Pre 90 post 95	35
6	M	SF	R	FL	18	13	Pre 90 post 0	Pre 90 post 150	150
7	M	FO	R	FL	15	17	Pre 30 post 70	Pre 30 post 115	45
8	M	SF	R	FL	16	9	Pre 0 post 0	Pre 5 post 90	90
9	F	JRA	R	FL	14	5	Pre 05 post 60	Pre 90 post 120	60
10	F	OM	R	FL	14	9	Pre 120 post 60	Pre 135 post 140	50
11	M	JRA	R	FL	11	6	Pre 80 post 30	Pre 135 post 130	100
12	M	FO	R	FL	14	17	Pre 90 post 0	Pre 90 post 110	110

SF supracondylar fracture, *JRA* juvenile rheumatoid arthritis, *FO* olecranon fracture, *OM* osteomyelitis, *FL* fascia lata, *S* skin, *GL* gel foam *FU* follow-up, *ROM* range of motion

20 years' follow-up. Twelve cases of interposition arthroplasty were evaluated. Nine were males, three were females and ages ranged from 10 to 19 years at the time of surgery. Eight cases were right sided and four were left sided. There were cases with sequelae of elbow fractures, five with supracondylar fractures, two with fractures of the olecranon, four with juvenile rheumatoid arthritis and one followed osteomyelitis.

Surgical techniques

Broadly speaking, there are two types of arthroplasty, apart from total joint replacement, that can be performed at the elbow region. The first is the functional type described by

Hass [3], concerned mainly with the resection of the ankylosed elbow joint, extirpating a great part of the distal end of the humerus, the proximal end of the ulna and, if necessary, the radial head. The V section of the humerus distal end cuts laterally with the long arm of the V on the anterior face (flexor). All this dissection is done subperiosteally.

The second class of arthroplasty of the elbow, the anatomical type, was described by MacAusland and modified by Vainio (with a wider resection of the osseous ends and total covering of the bloody surfaces), and is the procedure used by our team. The elbow joint is approached with a semi-circular incision that curves above the olecranon extending from one condyle to the other. The skin and subcutaneous tissue is dissected and the flap

Fig. 4 **a** Post-operative flexion.
b Post-operative extension

brought back. The ulnar nerve is retracted towards the ulna. A transverse incision is made over the aponeurosis ligaments and capsule up to the periosteum. The olecranon is transversely osteotomised following the joint line. When the joint cavity is totally obliterated by an osseous bridge, the position of the old joint line must be accurately determined and sectioned with chisel or saw. The forearm is flexed, the olecranon sectioned free and the flap dissected back completely. This flap is preserved to cover the joint later on. Ten fascia lata, one skin graft and one Gelfoam interposition material were used.

When remodelling the articular surfaces, the joint outline should be followed as closely as possible. The articular ends should fit exactly. Care must be taken to resect the bone just enough to permit free movement. An interposition flap from the fascia lata or inverted skin (Fig. 1) is harvested from the external part of the thigh. After cleaning the graft from fat, it is wrapped around the remodelled humeral condyles and attached to the capsule both anteriorly and posteriorly (Fig. 2). The articular ends are brought together. The capsule is closed using equidistant stitches, as is the skin. A small compression bandage is applied, and the arm is immobilised with a neck to wrist sling, with the elbow flexed slightly greater than a right-angle position. Rehabilitation is begun as soon as possible. If in 3 weeks the flexion does not improve, a manipulation under anaesthesia should be performed (Fig. 3).

Follow-up in this study ranged from 25 to 32 years. Pre-surgical range of motion was between 90° and 120° of flexion and 30° and 90° of extension. Five patients presented with ankylosis of the elbow.

Results

From a functional point of view, our results could be considered satisfactory (Table 1).

The total range of motion varied from 35° to 150°. Results for patients who were able to perform flexion of 120° or greater were considered to be excellent, those between 90° and 119° good, those between 60° and 89° fair and those 59° and less poor. Post-operatively the ranges achieved were between 90° and 150° of flexion. The five

cases of ankylosis reached a range of motion from 90° to 150° of flexion and from 0° to 70° of extension. Hand to mouth flexibility requires a mobility of 120°. Excellent results were attained in cases 4 and 6, (Fig. 4a,b) good results in cases 8, 11 and 12, fair results in cases 1, 2, 3 and 9 and poor results in cases 5, 7 and 10.

Fascia lata was used in all cases except two, obtaining excellent to good results in five.

Conclusion

The MacAusland technique modified by Vainio should be the procedure of choice in interposition arthroplasty with fascia lata in children and adolescents requiring a mobile elbow.

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