Total elbow arthroplasty for distal humerus fractures in patients older than 65 years

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Abstract

Objective: To report the clinical-functional results of humeral distal fracture treatment with total elbow prosthesis in patients older than 65 years.

Methods: Retrospective study performed in two surgical centers. Inclusion criteria: patients with humeral distal fractures, >65 years, operated on with Coonrad-Morrey prostheses, and with a follow-up >1 year. Twenty-one patients were included (20 women) with an average age of 79 years. According to AO classification: 13 type C3 fractures, 7 C2 and 1 A2. All patients were operated on without disinsertion of the extensor mechanism. Average follow-up: 40 months.

Results: Flexion-extension: 123-17°, with a total arc of mobility of 106° (80% of the contralateral side). Pain according to visual analogue scale was 1. The Mayo Clinic score was 83 points, results were excellent (8 patients), good (11 patients), regular (one case) and bad (one case). Average DASH score was 24 points. No loosening of the implants was evidenced in 13 patients. Nine complications were reported: 2 reoperations for polyethylene wear, one early decoupling of the prosthesis, 2 ulnar nerve paresthesia, one patient presented a false intraoperative via, one hematoma that needed a local flap and 2 loosening of the prosthesis.

Conclusions: Treatment of humeral distal fractures with total elbow arthroplasty in patients older than 65 years may be a good therapeutic option, but indications must be limited to patients with complex fractures, bad bone quality, with osteoporosis and low functional demands.

Key words: Distal humeral fracture; supracondilar fracture; total elbow arthroplasty; older patients.

Level of Evidence: IV

Artroplastia total de codo para el tratamiento de fracturas de húmero distal en pacientes mayores de 65 años

Resumen

Objetivo: Comunicar los resultados clínico-radiológicos del tratamiento de las fracturas de húmero distal con prótesis-total de codo en pacientes >65 años.

Materiales y Métodos: Estudio retrospectivo en dos centros quirúrgicos. Criterios de inclusión: pacientes con fractura de húmero distal, >65 años, operados con prótesis total de Coonrad-Morrey y seguimiento >1 año. Se incluyeron 21 pacientes (20 mujeres), edad promedio: 79 años. Según la clasificación AO, 13 C3, siete C2 y una A2. Todos fueron operados sin desinserción del aparato extensor. Seguimiento promedio: 40 meses.

Conflict of interests: The authors have reported none.

Resultados: La flexo-extensión fue de 123-17°, arco de movilidad de 106° (80% con respecto al lado sano). Dolor según la escala analógica visual: 1 punto. El puntaje de la Clínica Mayo promedio fue 83: resultado excelente (8 pacientes), bueno (11 pacientes), regular (1 caso) y malo (1 caso). El puntaje DASH promedio fue de 24. No hubo aflojamientos en 13 pacientes. Se produjeron nueve complicaciones: dos pacientes fueron operados nuevamente por desgaste del polietileno, uno operado otra vez al mes de la cirugía para la recolocación del perno de ensamble, dos parestesias del nervio cubital, una falsa vía intraoperatoria, un hematoma de la herida que necesitó de un colgajo braquial y dos aflojamientos protésicos.
Conclusiones: El tratamiento de las fracturas de húmero distal con prótesis total de codo en pacientes >65 años puede ofrecer una opción terapéutica razonable, pero las indicaciones deben limitarse a fracturas complejas donde la fijación interna puede ser precaria, en pacientes con osteoporosis y con baja demanda funcional.

Palabras clave: Fractura de húmero distal; fractura supracondílea; prótesis total de codo; pacientes mayores.
Nivel de Evidencia: IV

Introduction

Distal humeral fractures (DHF) are infrequent injuries that generally occur in old women.[1-4]Figures have increased throughout the latest decades. Palvanen et al. reported an increase from 11/10.000, in 1970, to 30/10.000, in 1995, mainly in patients >80 years old, and with tendencies to go up.[5]

In this age group, bad bone quality plays an important role at the time of deciding the best treatment. Results of osteosynthesis vary, but complication rates are high.[2,6] Several authors have published good outcomes with total elbow arthroplasty. [7-16]

The purpose of this work is to report medical/X-ray results in the treatment of DHFs with the use of total elbow prosthesis in patients >65 years old.

Matherials and Methods

This retrospective study was carried out at two surgical centers. We included all the patients >65 years old with DHFs, operated on with total prosthesis Coonrad-Morrey (Zimmer®, Warsaw, IN, USA), with a time between the injury and the surgery <2 months and a follow-up > 1 year. We excluded pathologic fractures.

We did not lose any patient during follow-up. Two patients died within the year following the surgery of causes alien to the surgery, and we excluded them from the study. We included 21 patients (20 females and one male), who at the time of the injury averaged 79 years old (ranging from 65 to 87). Eleven had his/her right limb affected, whereas 10 had her left limb affected. Eleven cases had their dominant limb affected.

All the patients were assessed with anterior-posterior and lateral X-rays and, in the case of intra-articular fractures, we performed CT scan. As stated by the AO classification,[17] 13 fractures were type C3; 7 fractures were type C2 and one fracture was type A2. The time between the injury and the surgery was 14 days (ranging from 5 to 60) (Table 1).

The surgical technique has been previously described,[15] but we believe that it is important to describe its most relevant aspects. We get access to the joint by the Alonso-Llames approach, which respects the extensor apparatus of the fingers (Figure 1). We dislocate the olecranon radially to unveil the fracture. The bone fragments of the distal humeral are all removed. Once we have inserted both prosthetic components, we extend the elbow fully until cement hardens (Figure 2). We test motion and assess three aspects: the level of extension reached, which if it is limited forces us to perform anterior capsulectomy; if there is any blockage between the coronoid process and the anterior blade of the prosthesis, it is necessary to remove partially the coronoid process;[18] if there is any impingement between the prosthesis and the radial head, it is necessary to perform radial head resection. We close the surgical wound in planes and stitch the lateral and medial epicondyle muscles to the lateral and medial borders of the triceps muscle. The ulnar nerve is transferred anteriorily, although there is no medial epicondyle anymore to avoid perinerve fibrosis, and the ulnar nerve is not placed near the implant. We splint the elbow in 90º for 72 hours. Then, the patient starts with active flexion-extension exercises and rehabilitation at occupational therapy. It is necessary to avoid holding weights greater than 3 kg with the affected limb.

We assessed objective postoperative elbow motion with a goniometer and the elbow extension strength as stated by the scale M0 to M5.

For subjective evaluation we used the Mayo Clinic Score (MCS) [19] and the DASH (*Disabilities of the Arm, Shoulder, and Hand*)[20] score ranging from 0 to 100, where 0 is the best possible score and 100 is the worst possible score. Pain and satisfaction with the procedure were evaluated by the visual analog scale (VAS) ranging from 0 to 10.

X-ray evaluation was made with anterior-posterior and lateral X-rays taken in the immediate postoperative period, at month 1, at months 3, 6 and 12 every year and at the end of follow-up. We evaluated loosening as stated by the Morrey scale,[7] which classifies loosening as follows: grade 0, radiolucent line <1 mm that surrounds <50% of the interface; grade 1, radiolucent line = 1 mm that surrounds <50% of the interface; grade 2, radiolucent line >1 mm that surrounds >50% of the interface; grade 3, radiolucent line >2 mm that surrounds the whole interface; grade 4, gross loosening. We looked for heterotopic ossification (HO) and classified it in mild, moderate and gross. Average follow-up was 40 months (ranging from 13 to 96).

Table 1. Demographic data

Patient	Age	Sex	Affected limb	Dominant limb	Days from injury to surgery	AO	Follow-up (months)
1	70	F	L	No	5	C3	96
2	75	F	R	Yes	9	C3	86
3	81	F	R	Yes	7	C3	74
4	78	F	L	No	14	C3	62
5	74	F	R	Yes	60	A2	64
6	87	F	R	Yes	24	C3	36
7	86	F	L	No	10	C3	18
8	83	F	L	No	27	C3	36
9	80	F	R	Yes	8	C2	24
10	81	F	L	No	7	C3	16
11	82	F	L	No	21	C2	26
12	74	F	R	Yes	5	C2	16
13	87	F	R	Yes	17	C2	14
14	65	F	L	No	7	C3	16
15	73	F	L	No	9	C3	14
16	74	F	L	No	12	C2	13
17	75	F	R	Yes	9	C3	15
18	82	F	R	Yes	6	C3	88
19	80	F	R	Yes	8	C3	65
20	85	F	L	No	17	C2	33
21	83	M	R	Yes	12	C2	24

F = Female; M = Male; L = Left; R = Right

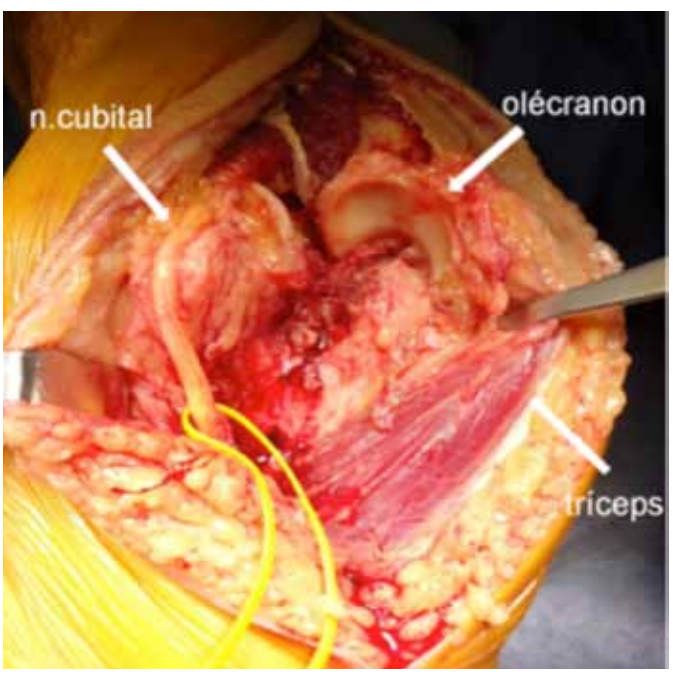

Figure 1. Paratricipital approach that respects the extensor apparatus of the fingers.

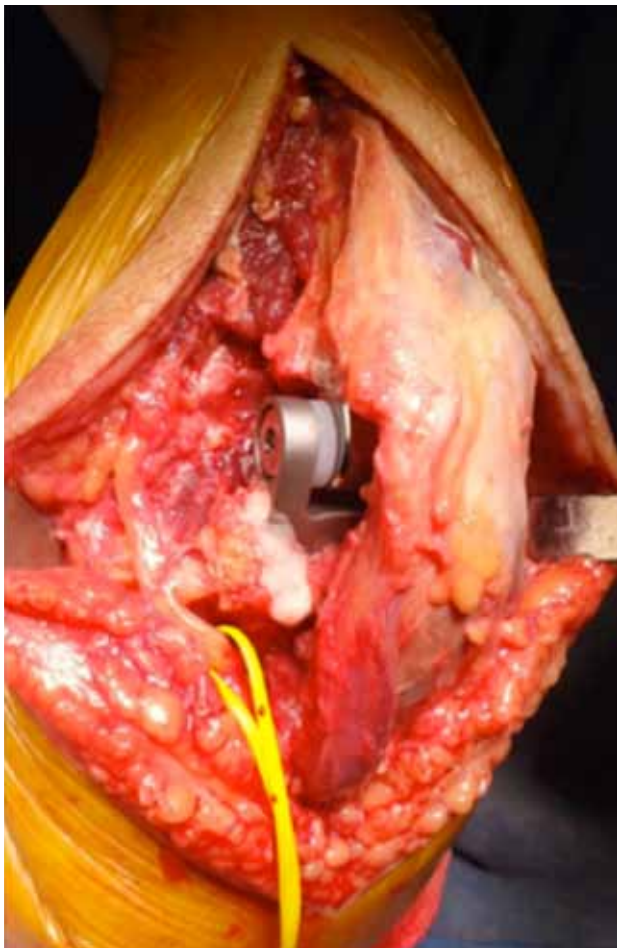

Figure 2. Once the components have been inserted, the extensor apparatus of the fingers remains attached.

Results

Average flexion was 123º (ranging from 100º and 140º) and average extension was 17º (ranging from 0º and 45º), what represents an average arc of motion of 106º (ranging from 140º to 75º). The contralateral limb showed an average arc of motion of 132º (ranging from 70º to 140º), what represents motion of 80% in the injured limb as compared to the unaffected limb.

Extension strength was M4 in four patients and M5 in 17 patients. Average pain as stated by the VAS was 1 point (ranging from 0 to 5). Nine patients showed pain=0 in this evaluation.

The average MCS was 83 points (ranging from 30 to 100); eight patients had excellent results; 11, good results; one, regular results, and one, bad results. The average DASH score was 24 (ranging from 8 to 78) (Table 2). The degree of satisfaction judging by the VAS was 8 (ranging from 4 to 9).

Prosthesic loosening was classified as grade 1 (5 patients), grade 2 (one case) and grade 4 (2 patients). Thirteen patients showed no prosthetic loosening.

We detected gross HO (one patient), moderate HO (one patient) and mild HO (7 cases); 12 patients did not show HO.

There were nine complications: two patients were operated on again due to polyethylene wear (change of the polyethylene and the assembly bolts) (Figure 3); one patient was operated on again at week 2 to insert again the assembly bolt due to the failure of the first insertion; two patients suffered paresthesia in the ulnar nerve's territory. One patient suffered necrosis of skin and subcutaneous tissue due to hematoma, what required a brachial flap for coverage. Two patients suffered loosening of the humeral component, but did not want to undergo another surgery. There were no infections.

Discussion

The classic treatment of DHFs is reduction and osteosynthesis. In young patients it is the treatment of choice and good bone quality often facilitates fixation.[21,22] It is not the same in the elderly, in whom, in general, fractures are complex and show from moderate to great comminution and osteoporosis. Osteosynthesis can be less stable and, in these cases, the patient has to receive more immobilization, what increases the risk of complications and bad outcomes. It is here that the prosthetic replacement can play an important role in the treatment.

The first indications of arthroplasty in relationship with trauma was for the treatment of fracture sequels or nonunions.[23-25] However, throughout the years, different authors have been reporting the outcomes of acute injuries.

In 2004, Kamineni and Morrey[26] published the results in 43 patients operated on for DHFs. After an average follow-up of seven years, 93% of the patients showed excellent and good results, with a flexion-extension arc of 131-24º. X-rays showed radiolucent lines in nine patients, and there were reports of complications in around 50% of the cases—11 infections, three ulnar fractures and three cases of prosthetic loosening that required prosthetic revision. Later on, other studies confirmed these preliminary results.[10,11,13,27,28]

Frankle et al.[11] were the first ones in reporting better results with arthroplasty than with internal fixation in patients >65 years old, with fewer complications (14% in the arthroplasty groups vs. 26% in the external fixation group).

McKee et al.,[29] in a prospective randomized study that also compared prosthetic replacement vs. osteosynthesis, concluded that the results of the prosthesis in complex

Table 2. Results

Patient	Flexion (º)	Extension (º)	Arc of motion (º)	Contralateral flexion-extension	Mayo Clinic Score	DASH	VAS	Loosening	Heterotopic ossification	Triceps strength	Complications	Satisfaction
1	140	5	135	140/0	90	27	2	No	Mild	M5	Polyethylene and bolts change (6 years)	9
2	135	10	125	135/0	100	13	0	1	Mild	M5	No	8
3	130	30	100	135/0	100	25	1	No	Moderate	M5	No	8
4	130	15	115	135/0	90	35	2	2	No	M5	No	8
5	140	0	140	140/0	100	10	0	No	No	M5	Polyethylene and bolts change (5 years)	8
6	130	40	90	110/40	30	69	5	4	No	M4	No	4
7	125	5	120	135/0	75	32	1	No	No	M5	No	8
8	135	30	103	140/0	75	78	1	No	Gross	M5	Fake pathways ulna and humerus	7
9	125	40	85	135/0	100	18	0	No	No	M4	No	8
10	110	35	75	135/0	70	24	1	No	Mild	M5	No	8
11	130	10	120	135/0	75	34	2	1	No	M5	No	9
12	125	20	105	130/0	80	23	4	4	No	M4	Loosening	7
13	125	30	95	135/0	75	15	1	No	Mild	M5	Loosening	9
14	125	25	100	135/0	85	14	1	No	No	M5	Skin necrosis-flap	8
15	125	45	80	135/0	85	11	0	No	Mild	M5	No	9
16	130	10	120	130/5	90	21	0	No	No	M5	No	8
17	130	5	125	135/0	85	32	1	1	No	M5	Ulnar paresthesia	9
18	110	5	105	130/0	85	10	0	No	No	M5	No	7
19	105	0	105	135/0	90	8	0	No	No	M5	Bolt loosening (2 weeks) insertion again	6
20	105	10	95	135/0	85	12	0	1	Mild	M5	Ulnar paresthesia	7
21	105	5	100	140/0	85	13	0	1	Mild	M4	No	7

VAS = Visual analog scale.

Figura 3. Polyethylene wear with bolts rupture five years after the surgery, with an implant that shows no signs of loosening.

DHFs in patients >65 years old were more trustworthy than those of internal fixation.

In a systematic revision that compared osteosynthesis vs. prosthesis in patients >60 years old, Githens et al.[30] reported a greater deal of complications and new surgeries in the osteosynthesis group, although the final results did not show significant differences. It is worth mentioning that many of our fractures could also have been treated with osteosynthesis, and the decision for prosthetic treatment was made after evaluating every patient individually, and jointly with them. Therefore, arthroplasty comes up as another option among the therapeutic tools for this injury.

In 2013, Mansat et al.[31] published the results of a multicentric study on 87 patients >65 years old with DHF treated with arthroplasty Coonrad-Morrey. Most patients were women who averaged 79 years old. After 37-month follow-up, the MCS was 86 points, the Quick-DAHS score was 24 points, and 64% of the patients were painless. Forty-eight percent of the patients got an arc of motion of 100º, 23% (20/87) suffered complications and 9% (8 cases) required surgical revision.

Our two main objectives while treating our patients were good functional results in a short time and low complication rates.

In general, reports on prosthetic replacements show a functional arc of motion, with limitation in the last degrees of extension; in our series, such limitation was of 17º (slightly lower than that reported by other authors). This extension deficit has not been considered as a major problem by the patients in our series (Figure 4).

The possibility of dislocating the olecranon without detaching the extensor apparatus of the fingers allowed us to start early rehabilitation, what might explain the recovery of an arc of motion of 106º. And, on the other hand, it helped to keep the extensor apparatus of the fingers free from complications. In these cases, we do not believe it necessary to perform osteotomy of the olecranon to elevate the triceps, as described by other authors, [32], nor do we believe in detaching the triceps as described by Mansat et al. in most cases that they published.[31]

Keeping extension strength in the elbow has been important mainly in this age group who often uses canes for movement.

There were two cases of gross loosening of the humeral component, both associated with defects in cementation. These figures can be compared to other series'. We decided not to operate these patients on again due to their old age and the fact that they did not want to undergo another surgery. However, in younger patients it would have been necessary to carry out revision.

Another issue has to do with permanent paresthesia in the ulnar nerve's territory. Careful surgical management is mandatory, for due to the patients' old age, many times the neurologic deficit does not revert.

Polyethylene wear is a complication that according to different authors' reports show in low percentages (1.3% out of 919 implants, as reported by Lee et al).[33] This drawback occurred in two of our 21 patients. We believe that it could be associated with malalignment of the components—especially the humeral component. Total resection of the distal end of the humerus can create the conditions for the incorrect insertion of the implant, what could lead to overcharging both components. In both cases, we verified a prosthetic implant adequately cemented with healing of the previous graft, and the two patients did well after the change of the prosthesis.

Recently there have been publications about hemiarthroplasty, but reports have been on limited series and short follow-ups. This implant is indicated when the columns are intact to ensure stability, or if it is possible to perform columnar fixation. The surgical approach usually involves olecranon osteotomy. Reported complications are olecranon wear due to the humeral implant, impingement due to the columnar osteosynthesis, and prosthetic instability.[34,35] Nowadays we do not have this type of implants in our market. In spite of the high complication rates, 19 out of the 21 patients showed good and excellent results at final follow-up.

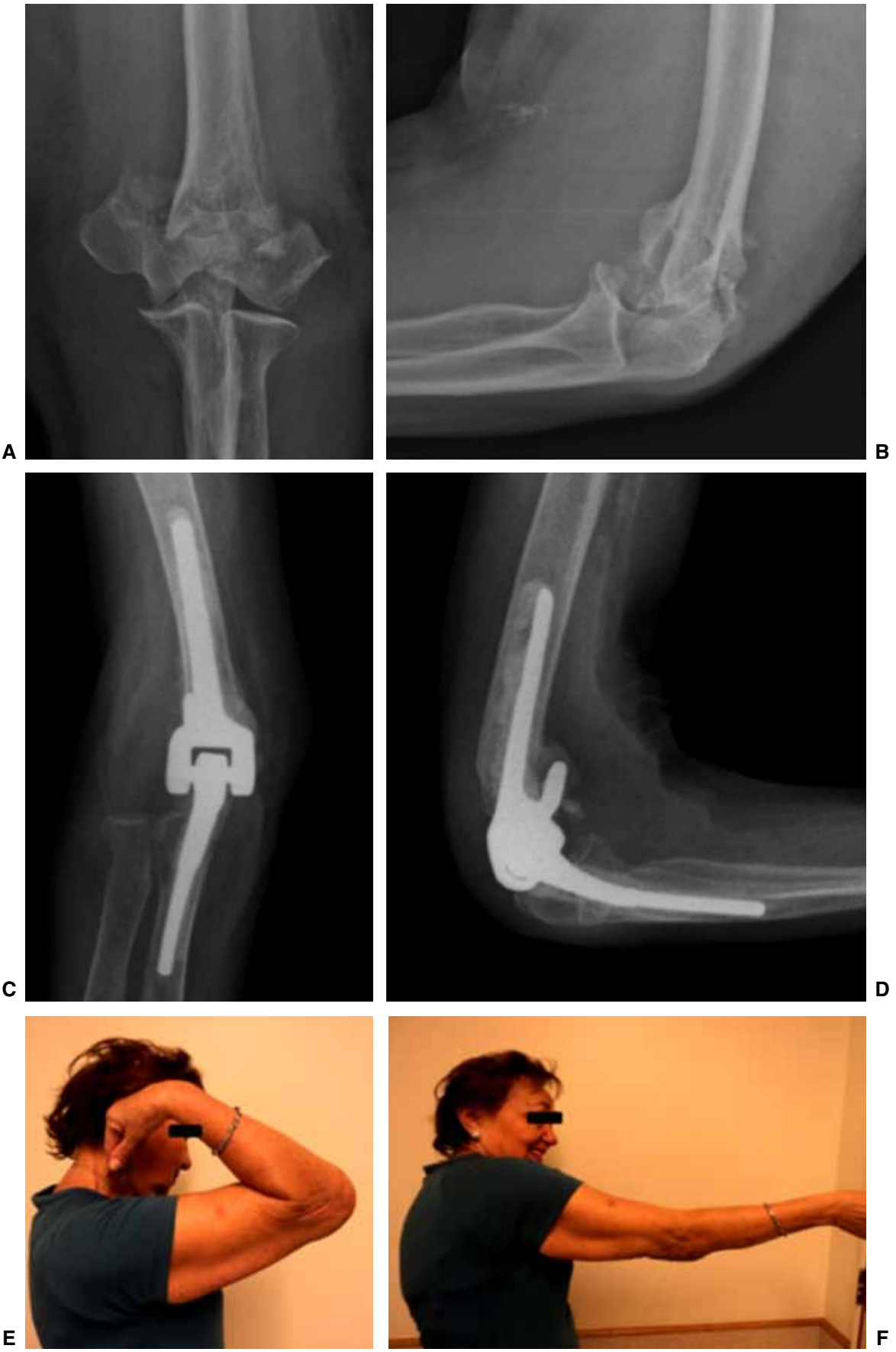

Figure 4. **A** y **B**. Preoperative X-rays. **C** y **D**. Postoperative X-rays. **E** y **F**. Final motion.

This work has certain limitations: it is a retrospective series, the number of patients is low, and they were operated on by different surgeons at different centers and assessed by different professionals.

However, it is a treatment scarcely reported in our literature in a consecutive series of patients the same age where no one of them has been lost from follow-up.

Conclusions

Treatment of DHFs with total elbow arthroplasty in patients older than 65 years old can offer a reasonable therapeutic option, but indications should be limited to complex fractures where internal fixation can be poor, in patients with osteoporosis and low functional demand.

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