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Bipolar radial head prosthesis implantation: a review of 15 cases

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Bipolar radial head prosthesis implantation: a review of 15 cases

Purpose. To analyze the results obtained with the implantation of radial head prostheses in our center and compare them with the results published in the literature.
Materials and methods. We carried out a descriptive retrospective study of Mason type III and IV radial head fractures treated in our hospital between July 2003 and November 2005 by jeans of prosthetic implantation. The series comprised 15 arthroplasties, of which only 12 were followed up appropriately (mean of 18.1 months). In order to assess clinical results, we used the Mayo functional score combined with other clinical parameters (loss of grip strength, length of time necessary to return to previous activity level). In radiological results, we considered proximal radial migration and any changes affecting the elbow and wrist joints.
Results. We obtained 6 excellent results, 3 good results,1 fair and 1 poor. The poor results required the implant to be withdrawn. None of the cases had associated wrist pain, although half of the patients reported loss of grip strength.
Conclusions. The promising results obtained would seem to indicate that radial head arthroplasty is a good therapeutic solution for fractures with elbow instability and for some fractures with no associated instability but which are not amenable to osteosynthesis. It should be said, however, that our follow-up is too short to be able to make any hard-and-fast assumptions on the implant's survivorship or long-term complications.

Key words: *radial head arthroplasty, radial head prosthesis, radial head replacement.*

Objetivo. Analizar el resultado de las prótesis de cabeza radial implantadas en nuestro hospital y compararlo con los resultados publicados en la literatura.
Material y método. Hemos realizado un estudio descriptivo retrospectivo de las fracturas de cabeza radial tipos III y IV de Mason tratadas en nuestro hospital desde julio de 2003 hasta noviembre 2005 mediante implantación de una prótesis. La serie comprendía 15 artroplastias, de las cuales solamente 12 presentaban un adecuado seguimiento (media de 18,1 meses). Para la evaluación de los resultados clínicos se ha empleado la escala de Mayo combinada con otros parámetros clínicos (pérdida de fuerza de prensión y tiempo de reincorporación a su actividad previa). En los resultados radiológicos se han considerado la migración proximal del radio y los cambios producidos en las articulaciones del codo y la muñeca.
Resultados. Hemos obtenido 6 resultados excelentes, tres buenos, uno regular y dos malos. Estos últimos requirieron la retirada del implante. No hemos tenido dolor en la muñeca en ningún caso, aunque la mitad de los pacientes refirieron pérdida de fuerza de prensión.
Conclusiones. Los resultados son esperanzadores, por lo que consideramos la artroplastia de cabeza radial una buena solución terapéutica en los casos de fracturas con inestabilidad de codo, y en algunos casos de fracturas no sintetizables sin inestabilidad asociada, aunque el seguimiento es demasiado corto para valorar la supervivencia y complicaciones a largo plazo del implante.

Palabras clave: *artroplastia de cabeza radial, prótesis de cabeza radial, sustitución de cabeza radial.*

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Radial head fractures are a very frequent pathology, accounting for 1.7 to 5.4% of all fractures and 33% of all elbow fractures[1]. Their severity spectrum is very large, ranging from isolated undisplaced injuries to comminuted fractures accompanied by elbow dislocation; the latter generally affect other structures like collateral ligaments, the

interosseous membrane, the coronoid process, the capitellum and the olecranon.

The current indication for radial head arthroplasty is limited to Mason type III and IV fractures that cannot be fixated and that are associated with valgus instability or with an Essex-Lopresti injury. Radial head resection remains a valid alternative for a stable elbow without injury to the interosseous membrane; however, some authors defend prosthetic radial head replacement in the case of initially stable injuries, mainly in younger patients, since when the elbow is pronated or maximally extended up to 60% of the load is communicated to the humerus through the radiocapitellar joint. If resected, the head ceases to transfer the load to the radiohumeral joint, and all stresses are conveyed from the distal radius to the proximal ulna through the interosseous membrane, which could distend the membrane causing the radius to migrate proximally, This would give rise to symptoms in the wrist as a result of the impaction of the ulna. Nevertheless, there are numerous long-term studies[2-4] that report very good results with simple resection, so radial head arthroplasty in stable elbows with unfixable injuries is a highly controversial indication.

In the present paper, we conduct a retrospective analysis of the functional and radiographic results of the radial head prostheses implanted at the Orthopedic and Trauma Surgery Department of our Hospital from July 2003 to November 2005 that have had at least a 6 months' follow-up.

MATERIALS AND METHODS

From July 2003 until November 2005, 15 radial head prostheses were implanted in our Department. We only managed to appropriately follow up 12 patients. Two subjects did not turn up at their scheduled follow-up sessions and could not be contacted on the telephone; another one moved to another city after recovering from multiple trauma.

The series includes 8 males and 4 females of ages ranging between 24 and 85 years (table 1). In 10 of them the fracture was caused by a fortuitous fall, and in 2 by a vehicle accident (patients number 6 and 11). In 5 of the patients the fracture was isolated, another 5 presented with Morrey type II or III coronoid fractures (treated conservatively), in one there was an associated trapezium fracture (patient 6) and in another the fracture was part of a multiple trauma scenario (subarachnoid hemorrhage, multiple costal fractures, flail chest, pelvic fracture and an elbow fracture-dislocation).

All patients were assessed preoperatively with anteroposterior and lateral elbow x-rays. In 4 cases we also used computed tomographic 3D reconstruction to better determine the nature of the lesion. The CAT-scan did not decisively contribute to obtaining an accurate diagnosis of the lesions or to adopting a final treatment decision. Fractures were classified according to Mason's criteria[5] as modified by Johnston[6].

The patients were operated by different surgical teams, with different anesthetic techniques. Surgery was performed 4 days alter admission[1-7]. Antimicrobial prophylaxis was performed preoperatively with a 2 g dose of intravenous cephazoline, and 3 further doses postoperatively. As far as the surgical technique is concerned, a lateral Köcher approach was used in all cases together with a radial neck resection and removal of the remainder of the head. Subsequently, a template was used to determine the point at which the cut on the radial neck would be made and a cemented Judet prosthesis was implanted (Tornier SA, Saint-Ismier, France) in all patients (fig. 1). Patient 6 had his lateral and medial ligaments and his flexor-pronator muscles reattached. It was also necessary to stabilize the elbow with a humero-ulnar K-wire for 3 weeks. None of the coronoid process fractures were fixated. Elbow stability was checked postoperatively. The post-op period was normal, without any complication related to the surgical wound or the prosthesis. We did not perform prophylaxis of heterotopic calcifications with indomethacin, but there were no complications of that nature. Patients stayed in hospital a mean of 3.1 days[2-5] after surgery.

The prosthesis is made up of 2 pieces that form a semiconstrained joint between them: a radial head made of a chromium-cobalt alloy that contains a high-density polyethylene liner, and an intramedullary stem manufactures with a chromium-cobalt alloy that is cemented in the medullary cavity of the radius. The neck of the stem forms a 15º angle with the diaphyseal portion. The bipolar joint permits an an-

Table 1. Characteristics of the patients included in the study

	Age	Gender	Type	Associated injury	Follow-up (months)
Patient 1	42	Male	IV	No	28
Patient 2	59	Female	IV	No	23
Patient 3	32	Male	IV	Coronoid fracture	22
Patient 4	35	Male	IV	No	23
Patient 5	26	Male	IV	No	14
Patient 6	27	Male	IV	Trapezium fracture	11
Patient 7	85	Female	IV	Coronoid fracture	15
Patient 8	24	Female	III	No	26
Patient 9*	45	Male	III	No	18
Patient 10	73	Female	V	No	25
Patient 11	48	Male	IV	Coronoid fracture, SAH, pelvic fracture, flail chest	6
Patient 12	29	Male	IV	Coronoid fracture	6

SAH: subarachnoid hemorrhage.

Figure 1. *Judet prosthesis used in this study.*

gulation of 35º in all directions, which in principle affords greater contact with the humeral condyle throughout the range of flexion.

The radial head is available in 2 different sizes: 19 and 22 mm in diameter. There are also two stem sizes: 8 mm in diameter and 60 mm in length, and 6.5 mm in diameter and 55 in length. Components can be mixed and matched to add a certain degree of modularity.

Table 2. Mayo Clinic scale

Total points	Distribution
Pain	
45	None
30	Mild
15	Moderate, tolerable, limits activities
0	Severe, constant, disabling
Function	
5	Combing one's hair
5	Eating
5	Getting dressed
5	Putting on one's shoes
5	Hygiene
Mobility	
20	> 100º
15	50-100º
15	< 50º
Stability	
10	Stable
5	Moderate instability
0	Unstable
Result	
Excellent	> 90
Good	75-89
Fair	60-74
Poor	< 60

All patients had their elbow immobilized with a splint for a mean of 21.1 days (range: 14-42). After the splint was withdrawn, they were assessed and treated by the Rehabilitation Department of our hospital; they attended a mean of 19 sessions of physical therapy (range: 10-32). The majority of patients gradually increased their range of motion after discharge from rehabilitation.

During the postoperative period, all patients were evaluated and treated by the Rehabilitation Department and attended a mean of 19 sessions until discharge.

After an 18.1 month follow-up (range: 6-28) the clinical results were assessed by jeans of the Mayo scale (table 2). Other parameters were also assessed, such as time of immobilization, subjective loss of strength and length of time elapsed until return to work or normal activity.

In the subsequent follow-up visits, all patients were administered anteroposterior and lateral radiographs of the affected elbow and of both wrists. In the radiographs, we assessed proximal radial migration (by means of the index by Fisher and Thule) as well as any arthritic changes, both proximal (humero-ulnar joint) and distal (radiocarpal joint). We also looked for osteoporosis in the *capitellum*, which seems to be associated to poor results), and for signs of stem loosening.

RESULTS

Preoperative findings

All patients included in the study presented with radial head injuries that were deemed impossible to fixate. In 2 cases these were Mason type III fractures and in the others they were Mason type IV fracture-dislocations. Intraoperatively, we carried out an examination under anesthesia to check stability.

None of the patients' wrist radiographs showed proximal migration of the radius, although it must be said that not all patients had their forearm examined in the Emergency Department to look for a possible lesion of the interosseous membrane.

Postoperative findings

Mayo Clinic Scale Assessment

The Mayo Clinic Scale was used to functionally assess all our patients' elbows (table 3). By analyzing the results of our series, one observes that mean range of motion was 114.20º in the group with excellent results, 106,7º in the group with good results, 80º in the group with fair results

Table 3. Table showing results on the Mayo scale

	Pain	Mobility	Function	Stability
Excellent (6)	None	114.2º	No restriction	3 stable 2 mdtly unstable 1 unstable
Good (3)	Mild	106.7º	No restriction	2 stable 1 mdtly unstable
Fair (1)	Severe	80º	No restriction	Mdtly unstable
Poor (2)	1 mod., 1 severe	90º	2 fctns impossible	1 stable 1 mdtly unstable

Mod: moderate; mdtly: moderately; fctns: functions.

and 90º in the group with poor results. Of the 12 patients in the study, 6 obtained an excellent result and 3 a good result; there was one fair and two poor results. The mean score was 80.4, which globally corresponds to a good result. There were no significant differences between the groups as to age, type of injury, associated lesions, etc., probably due to the small size of the sample. Table 4 shows the results obtained on the Mayo scale by the different patient groups.

Loss of prehensile strength

Half the patients reported a subjective loss of prehensile strength, even if 2 obtained an excellent result and another 2 a good one on the Mayo scale.

Return to work

Mean sick leave was 5 months for the group of patients, but if we exclude patient 8, who took 18 months to return to

Table 4. Results obtained by our patients

	Age	Mayo score	Mobility (F-E, P, S)	Wrist pain	Prehensile strength loss	Return to work or normal life	Complications	X-ray
Patient 1	42	E (45, 15, 10, 25)	30-130, 90, 90	No	No	3 m (waiter)	No	
Patient 2	59	Poor (0, 20, 5,15)	10-140, 90,90	No	Intense	No	Implant withdrawn Excellent mobility No infection	
Patient 3	32	E (45, 15, 10, 25)	30-120, 50, 90	No	No	2 m (painter)	No	
Patient 4	35	G (30, 20, 5, 25)	10-150, 90, 90	No	Mild	3 m	No	Capitellar Osteoporosis Sequelae of forearm fracture
Patient 5	26	G (30, 15, 10, 25)	10-100, 90, 60	No	Mild	3 m	No	
Patient 6	27	E (45, 20, 5, 25)	10-140, 90, 90	Until 3 m	No	4 m (security)	No	Minimal proximal migration
Patient 7	85	F (15, 15, 5, 25)	20-100, 90, 45	No	Moderate	2 m (pensioner)	No	Coronoid fracture
Patient 8	24	Poor (15, 15, 10, 15)	40-90, 90, 45	No	No	18m	Arthroscopic arthrolysis Prosthetic removal prosthesis G MS (30, 15, 5, 25)	Large
Patient 9	45	E (45, 20, 10, 25)	10-130, 90, 90	No	Mild	3 m (driver)	No	
Patient 10	73	E (45, 20, 0, 25)	10-135, 90, 90	No	No	3m (pensioner)	No	Arthritic capitellar changes
Patient 11	48	G (30, 15, 10, 25)	40-130, 60, 60	No	No	No (other pathology)	No	Coronoid
Patient 12	29	E (45, 20, 5, 25)	20-140, 90, 90	No	Mild	4m (painter)	No	

E: Excellent; G: Good; F: fair; F-E: flexion-extension; P: pronation; S: supination. MS: Mayo score.

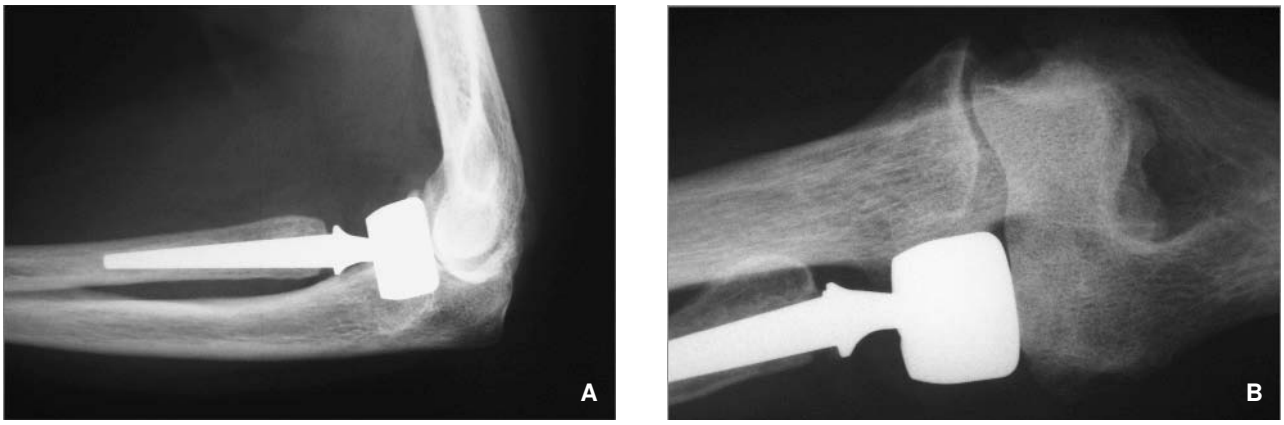

Figure 2. Patient 2. *(A, B) The radial head is lengthened if we take the coronoid process as a reference. (B) The radiograph shows osteoporosis in the capitellum and a reduction of the radiocapitellar space.*

his previous activity, the mean duration of sick leave decreases to 3.14 months. All patients, except for subjects 4 and 8, went back to their previous job.

Clinical results

Patient 2 presented with almost full mobility, restricted only by a slight 10º flexion lag. The x-rays showed no pathological sign but the patient reported a continual pain of an inflammatory nature that interfered with her sleep and prevented her from returning to her normal activities. All complementary tests performed (erythrocyte sedimentation rate, C-reactive protein, gammagraphy with 99Tc and gammagraphy with labeled leucocytes) were normal, so the presence of infection was ruled out. The symptoms improved following prosthetic removal.

Patient 7 complained of moderate pain, but she was satisfied with the result of surgery and soon went back to her fair activities.

Patient 8 was subjected to an arthroscopic arthrolysis in order to increase her range of motion. However, the procedure revealed a chondral lesion in the capitellum, which prevented the symptoms from disappearing. The decision was made to remove the implant in a second surgical stage. Fexion-extension increased from pre-op levels between 40º and 90º to 10º-130º postoperatively (after prosthetic removal). These results are in line with those published by Birkedal et al[7], who achieved a mean mobility gain of 26º following prosthetic removal in 4 patients in whom poor results had been obtained, without having any associated wrist problems or residual instability.

The remaining patients had good or excellent clinical results.

None of the other complications reported in the literature have appeared in the series (posterior interosseous nerve palsy, implant dislocations or subluxations, infections, heterotopic ossifications or complex regional painful syndrome).

X-ray results

No correlation was observed between x-ray and clinical results.

Patient 2 (fig. 2) presented with excessive radial head length. Applying the criteria by Fisher and Thule, only a slight proximal migration could be observed in patient 6. Patient 8 (fig. 3) presented with an oversized implant that clearly overhung the lateral border of the capitellum. Osteoporosis was detected in the capitellum of patient 2 and major arthritic signs – more advanced than in the contralateral side – in patient 10.

DISCUSSION

The classification by Mason[5], later modified by Johnston[6], has shown itself to have little therapeutic significance; it is a merely descriptive scale. In Mason type IV fractures, it does not provide information about the type of radial head injury the patient presents with, and it gives no clues as to what the right treatment should be. Hotchkiss[8] proposed a modification using only the radial head fracture as a criterion for classification, without taking into account any associated lesions found in the elbow.

The greatest controversy in the literature revolves around the treatment of Mason type III fractures. While some authors like Mezera et al[9] claim that Mason type III fractures with no associated ligament damage should be addressed with a simple radial head resection, others relieve in the need of replacing the radial head in order to avoid hyperpressure-related sequelae in the humero-ulnar joint and the proximal migration of the radius in the long term. Leppilahti et al[10] carried out a retrospective study with 23 sim-

ple radial head excisions in Mason type II and III fractures: 12 patients presented with either poor or fair results, half of them had wrist pain and decreased prehensile strength alter a mean follow-up of 5 years, and 17 patients presented with arthritic changes in the humero-ulnar joint. Ikeda et al[11] presented a series of 15 patients with a mean follow-up of 10 years in which only 5 patients were asymptomatic. They advised against this procedure in athletes and in manual workers. There is a striking discrepancy between these data and those in the classical series[2-4] in which results were better since most patients were symptom-free after longer follow-ups.

With the current level of experience, a logical attitude could consist in indicating arthroplasty in Mason type III fractures in young patients with high functional demands, and keep simple resections for elderly patients or largely sedentary individuals; in fractures with valgus instability or where injury to the interosseous membrane is suspected, prosthetic replacement of the radial head becomes necessary. Judet[12] claims that resection is a valid alternative in stable unfixable fractures, although he adds that a careful elbow examination must be carried out under anesthesia and, if the slightest degree of instability is detected, a prosthesis must be implanted to avoid fast-evolving arthritis to affect the humero-ulnar joint.

In our hospital, the classical treatment for these fractures has consisted in the resection of the radial head, with acceptable results being obtained. There is very little information about the long-term results of these prostheses and, as we said above, these are not exempt from problems (25% of fair and poor results), which means that they should only be indicated with parsimony.

Many descriptive studies have been published on the anatomy of the proximal radio-ulnar and humero-radial joints. Van Riet et al[13] concluded that in most people the radial head has an elliptical shape; Captier et al[14], in a study of 96 human cadavers, found that there are two types of radial head morphology: elliptical (57%) and circular (43%). These authors think that these anatomical differences could become biomechanical differences, which could have implications for the prosthesis' functional performance.

Currently there are two kinds of prosthetic designs: bipolar and monoblock. The studies carried out to compare their biomechanical qualities[15] have shown that monoblock implants are more efficient in restoring la valgus stability

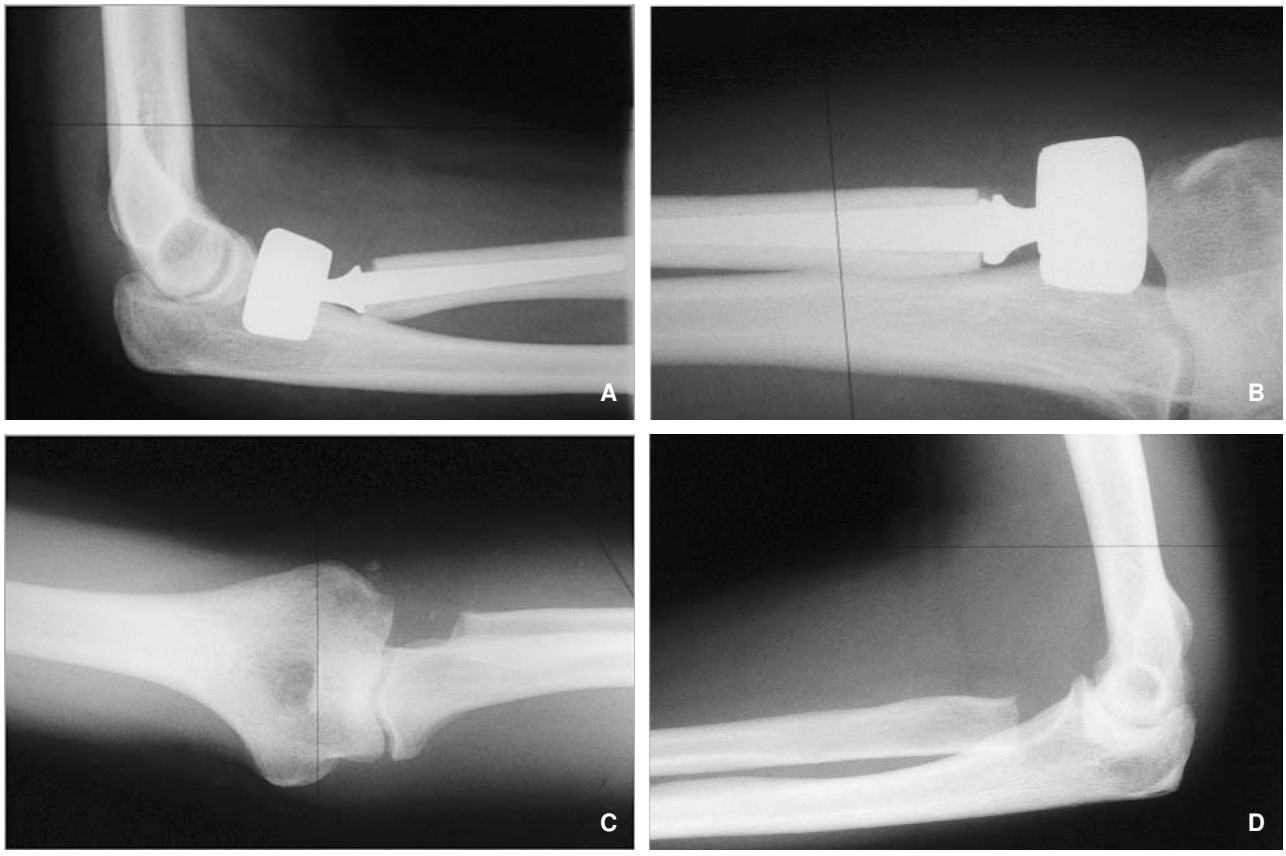

Figure 3. *Patient 8. (A,B) Views prior to implant removal. The radial head is not lengthened, using the coronoid process as a reference.(C,D) Views following implant removal.*

and avoiding proximal radial migration. Other cadaver studies[16] do not find significant differences and conclude that both types are efficient valgus stabilizers and that both prevent proximal radial migration, albeit less effectively than the native radial head.

Range of motion does not have much of an influence on the overall Mayo score obtained. In fact, patient 2 had excellent mobility but had so much pain at rest that we were forced to withdraw the prosthesis. In the Mayo scale, pain is the most significant criterion, with pain-free status being indispensable to obtain an excellent score.

One of the most important tasks to be performed when implanting a radial head prosthesis is to accurately restore the length of the radius. According to the work by Van Glabbeek et al[17] a lengthening over 2.5 mm may lead to impaired prono-supination, an extension lag and varus and externally rotated humero-ulnar motion. In addition, excessive lengthening could make the prosthesis subluxate posterolaterally leading to hyperpressure at the level of the capitellum causing pain and even cartilage damage. In turn, shortening greater than 2.5 mm leads to valgus laxity, proximal radius migration and valgus and internally rotated ulnar motion. The design of new prostheses has taken all of these factors have taken into account. Such implants come with instruments that enable more accurate radial length restoration. Doornberg et al[18] carried out a statistical study and used CT-scans to analyze 17 and find some constant reference that may help restore the exact radial length with these prostheses. They came to the conclusion that the best option was the coronoid process. The mean distance between the crest of the coronoid process and the articular surface of the radial head is 0.8 mm, and if the lateral margin of the coronoid process is taken as a reference the distance is 0.9 mm. On the face of these results, authors suggest performing x-rays of the healthy elbow to compare these relationships and implant the prosthesis at the level of the lateral margin of the coronoid process, assuming that there will be a shortening of around one millimeter to be sure that the radial neck will not be lengthened. If we use this bibliographical criterion to analyze the 2 poor results obtained, we will see that the length of the radius is increased in patient 2 but not in patient 8.

Patient 8 had her implant removed, although she had been previously subjected to an arthroscopic arthrolysis that showed a severe lesion in the capitellar cartilage. Initially, this was attributed to an excessive length of the radial neck, but when the coronoid process was used as a reference, as recommended by Doornberg et al[18], it did not seem to be lengthened (fig. 3). Those radiographs showed that the prosthesis was too large since it significantly overhung the capitellum. The patient was reexamined once the prosthetic radial head was removed, a good result being obtained on the Mayo scale with a significant gain in range of motion (10-130º flexion-extension),full pronation and -30º supination. Pain went from moderate to mild and, for now, the patient does not present with significant instability or pain at the level of the wrist.

Patient 2, who also obtained a poor result, did appear to show a certain amount of lengthening of the radial head as calculated by means of the references cited above (fig. 2); he has recently had his implant withdrawn and still has to be reassessed.

The size of the radial head prosthesis seems to have less importance. At the beginning, authors were all for larger sizes to reduce the pressure on the capitellum, but studies like that by Liew et al[19], carried out on cadavers, proved them wrong. The contact area between the capitellum and the radial head prosthesis is two thirds that of the native radial head and the more the elbow is flexed, the smaller this area becomes. The contact area is slightly smaller with larger prostheses, although this is a factor authors do not seem to attach too much importance to. Bipolar prostheses seem to maintain a larger contact area with the capitellum than the monoblock ones, with difference being more marked when the elbow is flexed. In addition, cases have been described where overly large prosthetic radial heads have so much as impinged on the lateral aspect of the coronoid process[20].

Stability is a parameter that the Mayo scale leaves largely unspecified. Indeed, as the scale does not clearly define this criterion, its interpretation is left to the examiner. In our review, we have used the healthy side as a reference: slight increases were regarded as instances of moderate instability and large ones as instances of evident instability. There was one single case of evident instability (an 85-year-old patient), but this did not interfere with his usual activities or caused him pain when he extended his elbow; he did not complain about discomfort in the wrist either. Moderate instabilities did not have functional repercussion.

The loss of prehensile strength is a factor not considered by the Mayo scale but which greatly influences patient satisfaction; most scales used for assessing these implants include it among their criteria. Patient 4, classified as obtaining a good result, was forced to abandon his job as a brick-layer a few months after he went back to it because of pain and the inability to perform hard work (he currently Works for a security company).

Immobilization time in our patients was too long if compared to the reports in the literature given that they had their elbow immobilized at 90º and in neutral pronosupination for 3 weeks. In many of the published series, the most usual factor that restricts elbow motion is an extension lag; for that reason, Bain[21] recommends starting rehabilitation with passive exercises at 24-48 hours from surgery and suggests using a night-time splint to keep the arm extended for 6 weeks. Patients in the series published by Bain[21] received a prophylactic dose of indomethacin to reduce the risk of heterotopic calcifications, which could increase as a result of early mo-

Table 5. Comparison of our results with those in the literature

Study	Result	Flexion-extension	Loss of wrist strength	Complications	Follow-up	No. of patients
Our series	2 poor 1 fair 3 good 6 excellent	105.4º	33% mild 8.5% moderate 8.5% intense	2 prosthetic removals	18.08	12
Judet[22]	2 excellent 3 good	146º	-	No	49	5
Bain[21]	8 excellent 5 good 3 poor	Flexion -5º Extension -15º	-	-	34	16
Harrington[23]	14 excellent 4 good 2 fair 2 poor	103º	10-20% vs. contralateral	4 prosthetic removals w/ subsequent improvement	20	12.1
Moro[24]	17 excellent 5 fair 3 poor	132º	20%	1 regional painful complex syndrome; 1 posterior interosseous paralysis; 1 ulnar neuropathy; 1 infection; 1 stiffness	25	39
Holmenschlager[25]	2 excellent 12 good 1 fair 1 poor	123º	10%	Posterior interosseous nerve palsy complex regional painful syndrome Aseptic loosening	16	19

bilization. The extension lag is a significant complication in our series, probably caused by the long immobilization time required. Nevertheless, the results obtained are similar to those published in the literature. Immobilization time depended greatly on the medical team that treated each patient, with some patients being required to keep their elbow immobilized for as much as 42 days. The last patients were the ones that had shorter immobilization times.

Judet[12] recommends a series of maneuvers that should accompany prosthetic implantation: repair of capsuloligamentous lesions, repair of Morrey type II and III coronoid fractures and early elbow mobilization supported by an external fixator in the case of very severe lesions. Another aspect that could be criticized about the present series is the fact that coronoid process fractures were treated conservatively in all cases. Only in patient 6 did we perform a revision and reattachment of the medial and lateral complex, including the flexor-pronator musculature as an added maneuver. In spite of not having routinely reconstructed its ligaments, or fixated the coronoid process, and in spite of an excessively long immobilization time, the results reported hereby are similar to those in the literature.

No correlation was found between clinical and radiological results; it is extremely difficult to predict the clinical evolution of a radial head prosthesis just by looking at a series of x-rays.

The clinical results (on the Mayo scale) obtained in our series are comparable to those published in the literature (table 5). In the series where the loss of strength was measured with dynamometers, a loss of 10 to 20% was observed as compared to the healthy side. In our series, 50% complain about having lost their prehensile strength subjectively, but we did not confirm this with a dynamometer.

The present series exhibits two weaknesses. In the first place, it is a retrospective study without a control group, which casts a shadow on the validity of the results obtained. Secondly, follow-up is short, which also calls into question the validity of results since both restoration of elbow stability and tolerance to the implant are apply to the short term. Future publications should look at the long-term evolution of patients bearing this type of implant and thus make a significant contribution to tip the scales in one or the other direction as far as treatment of Mason type III fractures is concerned.

To conclude, we can say that the short-term indication of a radial head prostheses to address ligament and/or interosseous membrane injuries has been demonstrated, but its usefulness in isolated non-reconstructible injuries of the

radial head remains to be shown. The management of elbow injuries with an accompanying radial head fracture is one of the areas that is undergoing most rapid changes in Trauma Surgery. The understanding of elbow kinematics as well as of the load transfer pattern and the anatomical variations of the radial head will determine the design of future implants and contribute to identifying the clinical-radiological prognostic factors of these implants.

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Conflict of interests

The authors have declared that they have no conflict of interests.