Total wrist arthroplasty in patients with rheumatoid arthritis. Evaluation of preliminary results

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Introduction. The wrist is one of the most commonly involved joints in Rheumatoid Arthritis (RA). Since the early 1970s, wrist arthroplasty has been introduced as an alternative to arthrodesis of the wrist, allowing maintenance of wrist motion, while at the same time relieving pain and increasing function.
Purpose. This study reports the short term clinical follow-up of total wrist arthroplasty in the rheumatoid, used to evaluate the effectiveness of this procedure based on objective and subjective results.
Materials and methods. Retrospective study of the 7 wrist arthroplasties in patients with rheumatoid arthritis implanted in our department since 1993:
1. Objective results: range of motion, stability and radiological evaluation according to the Cobb and Beckenbaugh scale.
2. Subjective results: pain and ability assessed by the EAV scale and the DASH questionnaire respectively, patient satisfaction and comparison between arthroplasty and arthrodesis.
Results. After the surgical procedure, both pain and ability, as assessed by means of the EAV pain scale and the DASH questionnaire, improved markedly. Overall ROM improved significantly. No signs of early radiographic failure were seen. Patient satisfaction with the procedure was high. All patients who had undergone fusion of the wrist on the opposite side would have preferred arthroplasty.
Conclusions. Although these good results help confirm the usefulness of wrist arthroplasty in RA, total wrist arthroplasty still yields less satisfactory clinical outcomes than hip and knee arthroplasty. Good patient selection a correct surgical technique, as well as the constant evolution in implant design, will help improve the results of wrist arthroplasty.

Key words: *total wrist prosthesis, rheumatoid arthritis, arthroplasty, wrist.*

Artroplastia total de muñeca en pacientes con artritis reumatoide. Evaluación de resultados iniciales

Introducción. La articulación de la muñeca es una de las articulaciones más frecuentemente afectadas en la artritis reumatoide (AR). Desde principios de los años setenta la artroplastia de muñeca se propone como alternativa a la artrodesis de muñeca para, además del alivio del dolor, incrementar la movilidad y mejorar así la función articular.
Objetivo. Evaluar los resultados objetivos conseguidos tras la cirugía, y los resultados subjetivos de la percepción del paciente tras la artroplastia de muñeca realizada a pacientes afectos de AR en nuestro centro.
Material y método. Estudio retrospectivo del resultado de las 7 artroplastias de muñeca en pacientes afectos de AR, realizadas en nuestro centro desde 1993:
1. Criterios objetivos: movilidad, estabilidad y evaluación radiológica según el método descrito por Cobb y Beckenbaugh sobre radiografías en anteroposterior y proyección lateral de muñeca.
2. Criterios subjetivos: el dolor y la habilidad medidos mediante escalas de EAV y DASH respectivamente, satisfacción del paciente y comparación de prestaciones con la artrodesis contralateral.
Resultados. Tras la cirugía el dolor y la habilidad (medidos mediante escalas de EAV y DASH) mejoraron de forma notable. La movilidad se vio incrementada de forma general mejorando muy significativamente. Radiográficamente no aparecen signos de fallo precoz. Casi todos los pacientes mostraron su satisfacción con el procedimiento quirúrgico. La preferencia de artroplastia a artrodesis es la norma.

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Conclusiones. Aunque estos resultados ayudan a confirmar las bondades de la artroplastia de muñeca en pacientes afectos de AR, aún está por conseguir el éxito de las artroplastias de cadera o rodilla. Una buena selección de pacientes, una buena técnica quirúrgica y la constante evolución en la calidad de los implantes, sin duda ayudarán a mejorar los resultados de la artroplastia de muñeca.

Palabras clave: *prótesis total de muñeca, artritis reumatoide, artroplastia, muñeca.*

The wrist is one of the joints most frequently affected by rheumatoid arthritis (RA)[1]. Although wrist arthrodesis has repeatedly shown itself to be a reliable method to provide stability and relieve pain in the rheumatoid wrist, it does so at the expense of sacrificing the joint's mobility. Since the beginning of the 60's, with the Swanson silicone rubber interpositional implants, wrist arthroplasty has been proposed as an alternative to wrist arthrodesis (or as a complement for the contralateral wrist) in order not only to relieve pain but also help increase articular function[1].

Correct functioning of the wrist joint depends on 2 principles: the tendinous structure and the mechanical balance[2]. The tendinous structure is seriously compromised in autoimmune diseases such as RA. The mechanical balance of the wrist joint depends on the distal radioulnar variance and on the carpo-metacarpal length, both parameters being severely distorted in patients with RA[3]. The wrist's minimal functional range of motion has been defined by Palmer[4] as 30º dorsal flexion, 5º volar flexion, 10º radial deviation and 15º ulnar deviation. Young showed that the carpo-metacarpal ratio (ratio of the distance from the distal radius to the base of the third metacarpal to the length of the thrid metacarpal) is 0.54 ± 0.03 in the healthy wrist and 0.40 in a wrist that is moderately or severely affected by RA[3].

Several generations of total wrist prostheses have been designed, developed and implanted since the first designs by Swanson[5]. Generally speaking, the basic principles that should be met by a wrist joint prosthesis are as follows:

1. Reconstruct the wrist's anatomical axes.
2. Restore the carpo-metacarpal ratio.
3. Relieve pain.
4. Improve range of motion.
5. Provide stable and lasting fixation.
6. Permit a straightforward and easily reproducible surgical technique.
7. Offer salvage options in case of implant failure.

So wrist prostheses are designed to relieve rheumatic wrist pain, maintain a normal carpo-metacarpal ratio and maximize the range of motion of the wrist with respect to its tendinous structure[2].

Total wrist arthroplasty can be scheduled as a single procedure or combined, in one or more stages, with procedures such as metacarpophalangeal arthroplasty or interphalangeal arthrodesis[7]. In patients where several upper limb joints are affected by RA, the wrist is key to restoring the hand's function so we think it should be treated in the first place in those cases. Other procedures, affecting bone and soft tissue, like synovectomies or tenolyses can be carried out in one single surgical stage and simultaneously to the placement of a wrist prosthesis in order to achieve a more efficient restoration of the joint balance and permit a better function of an already severely deteriorated rheumatoid wrist[7].

In this study we present our initial experience of 8 wrist arthroplasties carried out in rheumatic patients, in order to assess their effectiveness to improve wrist joint function, on the basis of objective criteria and the patients' subjective results.

MATERIALS AND METHODS

Between May 1984 and September 2005, ten wrist arthroplasties were implanted into 8 RA patients by one single surgeon at the Hand Surgery Unit of the Department of Orthopedic and Trauma Surgery of the Virgen de la Salud Hospital in Toledo.

The following prostheses were used: one Swanson silicone rubber interpositional wrist prosthesis; 4 cemented Biax total wrist prostheses (De Puy); 3 Universal prostheses and 2 KMI total wrist prostheses, one of them uncemented (fig. 1).

Of the 8 patients operated, 7 were included in our study, since one of them – the oldest – died. He was the one who had been implanted the only Swanson interpositional prosthesis in 1984.

The mean age at surgery of the 7 patients included in our study was 58 years (range: 29-72 years). As regards gender distribution, 5 patients were female and 2 male. Mean follow-up was 4.5 years (range: 1-13 years; between July 1993 to September 2005). All the arthroplasties were implanted in the non-dominant wrist; in addition, 3 patients already had a previous arthrodesis in the contralateral wrist.

Pain was the chief indication for surgery, accompanied by joint deformity and limitations to mobility and joint function. Approximate mean duration of symptoms in the involved wrist was 6 years (2-20 years). All patients presented with high levels of joint erosion and destruction on pre-op films, according to the scale by Larsen[8] (grades 0 to 5, where 0 represents x-ray normalcy and 5 a mutilating level of joint abnormality with total disappearance of the joint surfces). According to this scale, patients were rated as grade 3, and three as grade 4.

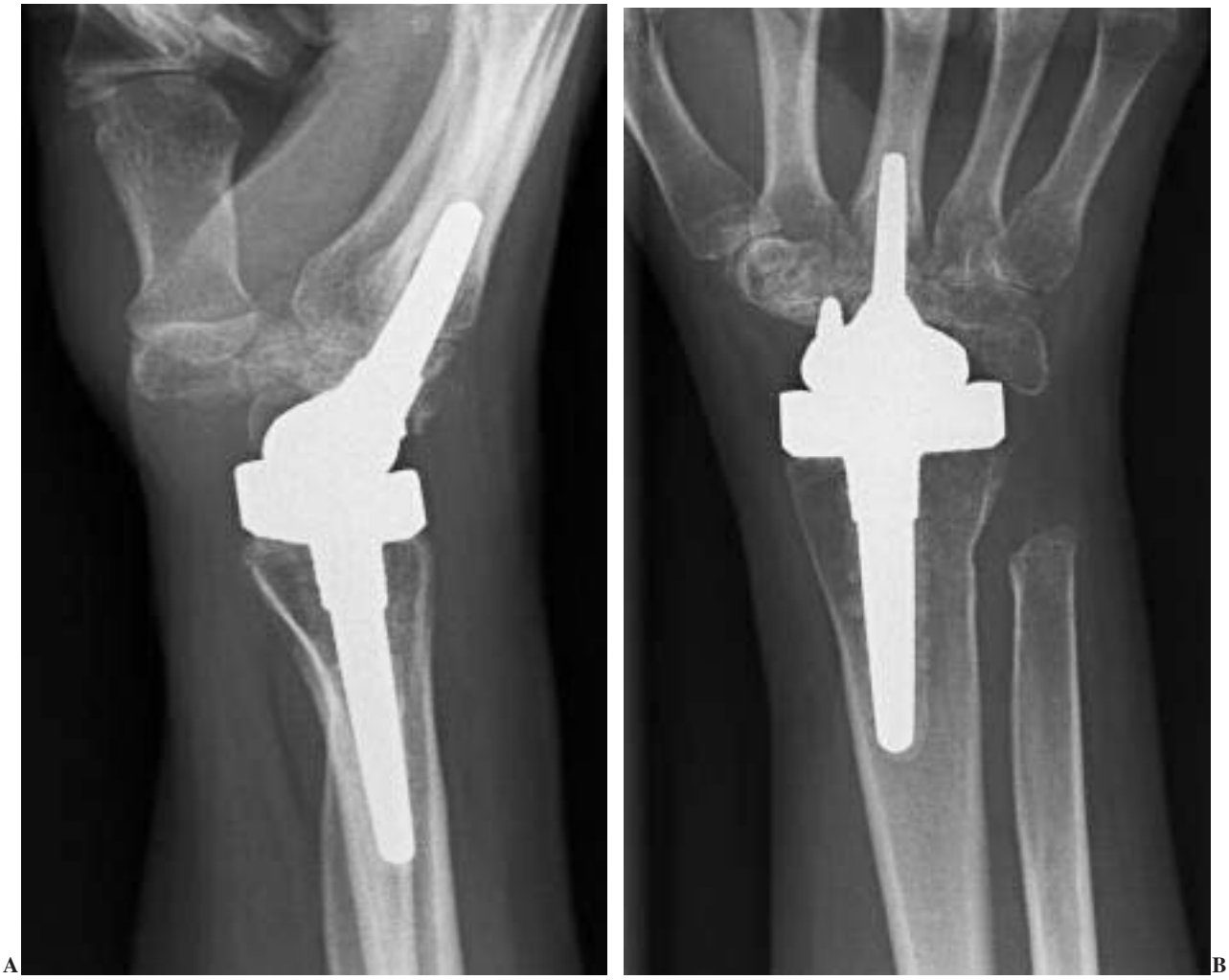

Figure 1. *Plain anteroposterior and lateral films of the wrist with a Biax total wrist prosthesis at 25 months.*

The surgical technique employed was that described by Swanson in 1973[9] with the modifications needed to place the different devices of the prosthetic models used. With other authors, we would like to underscore the need to achieve a perfect capsular reconstruction and a correct balance of the extensor mechanism. We consider the implantation of the prosthesis to be one of the parts in the surgical procedure carried out to reconstruct the rheumatoid wrist[10].

The parameters subjected to study were as follows:

1. Objective criteria: mobility, stability and x-ray assessment according to the method described by Cobb and Beckenbaugh using anteroposterior and lateral wrist radiographs.

2. Subjective criteria: pain and ability, measured by means of the visual analog scale (VAS) and DASH respectively, patient satisfaction and comparison with the contralateral arthrodesis.

As the weakness of the grip strength of moderate or severe RA patients is directly proportional to the weakness of the fingers rather than to that of the wrist, we did not include grip strength in our study[7].

RESULTS

Active range of motion

Flexion/extension, radioulnar deviation and pronosupination were measured by placing a goniometer at the back of the wrist on the prominence of the third metacarpal at the level of the midline of the forearm[4].

The mean values obtained were: palmar flexion, 33.1º (range: 11-55º); dorsiflexion, 30.7º (range 5-50º), radial deviation, 18.1º (range 12-22º) and ulnar deviation 20.6º (range: 4-35º) (figs. 2A y 2B). Mean pronation was 83º (range: 70-90º) and mean supination 80.1º (range: 69-90º).

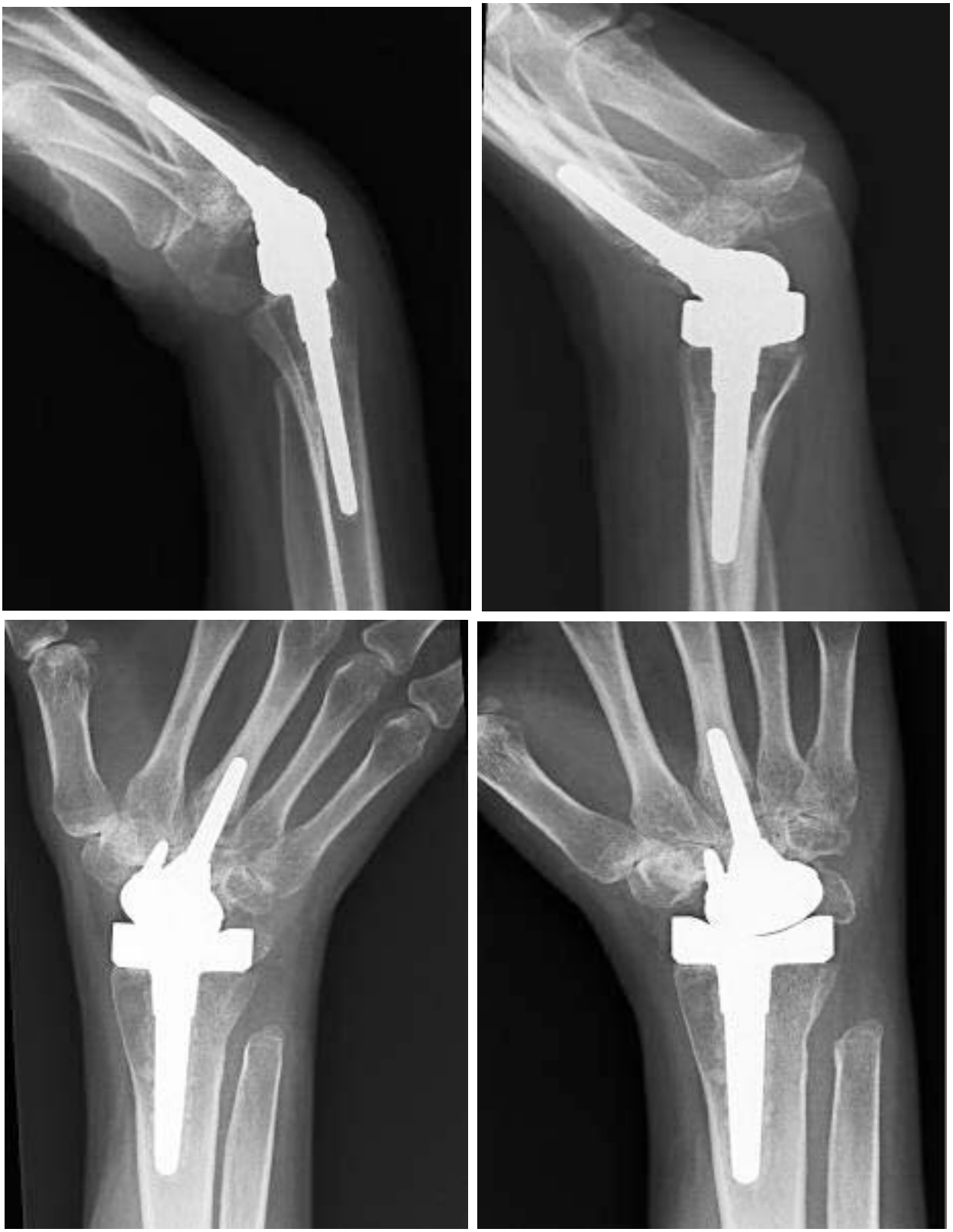

Figure 2. *Lateral (A) and anteroposterior (B) films of the wrist with a Biax total prosthesis at 25 months' follow-up. Note the active range of motion of the prosthetic wrist.*

Stability

Stability tests for wrist arthroplasty were carried out with the wrist at rest during the active range of motion[4], taking into account the potential abnormality/ normality of the position of the wrist and its influence on the joint's function or imbalance.

A fixed ulnar deviation was noted in one of the wrists. One patient had slight mid-flexion stiffness. The remaining patients showed good clinical stability, both with the wrist at rest and during the active range of motion.

Radiological assessment

For the x-ray assessment we used the method described by Cobb and Beckenbaugh[11] using anteroposterior and lateral wrist radiopgraphs to look for radiolucent lines or signs of loosening around the prosthetic components.

Of the 7 arthroplasties, 3 show radiolucent lines with no signs of clinical loosening. In all these cases the lines affect the distal prosthetic component.

Pain

All patients pointed to pain as their main symptom and the main factor that led them to undergo wrist surgery.

Pain, measured from 0 to 10 points on the VAS, went from a mean pre-op value of 9.2 (range: 8-10) to a mean post-op value of 2.5 (range:1-4). Only one patient reported residual postoperative pain following placement of the wrist prosthesis.

Ability

Of the 7 patients, 6 reported a significant improvement in their capacity to perform their activities of daily living and one said that, after an initial improvement, he later did not feel any improvement in his capacity to carry out his daily activities.

Mean DASH score (validated for Spanish) for the function of the upper limb[12], went from a 90 points pre-op to 47 points post-op, which again indicates a significant improvement in the capacity to carry out daily activities (such as opening a bottle, writing, opening a door, driving, drying one's hair with a towel, etc.).

Patient satisfaction

When asked about the result of their operation, 5 patients said they were highly satisfied, one said he was satisfied and one said he was dissatisfied with the result.

Six patients indicated that, taking into account the result obtained, they would undergo the surgical procedure again. Only one of the patients said that he would not subject himself to the operation again.

Arthrodesis vs. arthroplasty

All of the 3 patients with previous arthrodesis of the contralateral wrist were more satisfied with the final result of the arthroplasty that with that of the arthrodesis.

Complications

We had no intra-operative fractures. There were no problems related to wound healing or postoperative infections. To date no cases of instability or prosthetic dislocation have been reported.

Following surgery, pain and ability, as measured by means of VAS and DASH respectively, improved remarkably. Mobility increased significantly in general. Radiographically there were no signs of early failure. Nearly all patients showed themselves satisfied with the surgical procedure. Preference of arthroplasty to arthrodesis is the norm. The results obtained by our study are similar to those reported in the literature.

DISCUSSION

Prior to the development of the Swanson silicone rubber interpositional implant in 1967, arthrodesis was the surgical technique of Choice for relieving the symptoms of the advanced rheumatoid wrist: pain, deformity and functional impotency[13,14]. Following Swanson's implant[9], the designs by Meuli in 1970[15,16] and Volz in 1973[17] paved the way for a new surgical approach for the treatment of the advanced rheumatoid wrist.

An ideal wrist prosthesis must, in the first place, restore the normal anatomical alignment axes, provide a pain-free functional range of motion, and offer the patient lasting stability; the surgical technique must be consistent and reproducible[2].

Nowadays the main indication for wrist arthroplasty is the advanced rheumatoid wrist, although arthrodesis still has a role to play in treating the condition[4]. Contraindications are the loss of local innervation, the loss of active extension, local infection, inadequate bone stock, chronic subluxation and the need for a walker or crutches to ambulate[18].

In 1986 Dennis et al[19] reviewed 30 wrist prostheses with a mean follow-up of 5.5 years. They obtained 60% excellent/good results, significant pain relief (86%), and a subjective improvement post-surgery in 86% of patients.

In 1994, Bosco et al[4] published a review of 18 wrist prostheses and reported significant pain relief in 83% of patients. In 1996, Cobb and Beckenbaugh[11] in a series of 52 wrist prostheses, found that 75% of their patients reported complete or almost complete pain relief with a mean survival rate at 5 years of 83%. Finally, in 1997, Gellman et al[7] obtained a 72% rate of good results in wrist prostheses and pain relief in 86% of their patients.

Although these conclusions seem to confirm the good results of wrist arthroplasty, these results are still a far cry from the levels of success and reliability achieved by hip and knee arthroplasty.

Cooney et al[6] published a 23% failure rate for wrist arthroplasty at 5 years in 1984. Menon[20] admitted a 33% failure rate after a mean follow-up of 3.5 years in 1998.

When reviewing the etiology of prosthetic failures, Cooney et al identified 3 main causes: prosthetic malalignment, failed prosthetic fixation and soft tissue imbalance. Meuli[21] claims that most failures are directly related to a poor surgical technique and that these appear especially during the first year following implantation.

After reporting an 80% prosthetic failure rate in 2003, Radmer et al[22] ponder the possible causes for such an unusually high rate and point to lack of cementation and to failure at the bone/implant interface as one of the potential explanations.

As we report in the results of our study, the higher rates of osteolysis are to be found around the distal component[2,6,23]. These findings are in line with those published in the literature. More modern designs could benefit from enhancing the stability of the distal component thereby at least partly reducing the relatively high rate of prosthetic failure.

We think that the sample in our study, which includes only 7 wrist prostheses, is not sufficient to draw conclusions about the possibility that the two most frequently used implants, Biax y Universal Total Wrist, could perform differently.

In spite of the relatively high number of failures reported in the literature by comparison with other joint prostheses that have been on the market longer, such as hip and knee prostheses, it is surprising to note the high levels of patient satisfaction reported in virtually all studies[2,6,7,11,21,22]. The majority of patients who undergo a wrist arthrodesis, and subsequently an arthroplasty in the contralateral wrist tend to prefer the result of the arthroplasty[2,6], which suggests how much store rheumatic patients set by joint mobility, in spite of the fact that less than half of wrist arthroplasties achieve the range of motion refined as minimally functional[4]. This possibly reveals that what patients really want is to be free of pain but preserving their joint, albeit with a reduced range of motion[6].

Gellman et al[7] claim that wrist prostheses are especially indicated in cases of severe destruction and deformity of the wrist (Larsen grade 5). However, we believe, together with other authors, that provided that the patients' symptoms justify it, the sooner the implant is placed (Larsen stages 3-4) the better short and long term results will be achieved. This means that implantation should be made when the patient's bone stock is still abundant and their soft tissues still unharmed. Furthermore, should the arthroplasty fail at that point, conversion to a wrist arthrodesis does not involve major technical problems since the degree of bone resection needed for placing it is minimal[21].

In conclusion, it can be stated that total wrist arthroplasty affords satisfactory results in the reconstruction of the rheumatoid wrist, it offers better results than wrist arthrodesis, it leads to a good functional outcome and to a good level of patient satisfaction. However, more work is needed to equal the level of success and reliability achieved by other arthroplasties that have been on the market longer.

An appropriate selection of patients (only Larsen grades 3 and 4 patients are eligible). A good surgical technique and further developments in implant quality will no doubt help better the results achieved in total wrist arthroplasty.

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Conflict of interests

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