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ORIGINAL STUDY

Grammont's reverse shoulder prosthesis for rotator cuff arthropathy. A retrospective study of 32 cases

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The authors have retrospectively studied a series of 32 reverse shoulder prostheses implanted in 30 patients by the same surgeon between 1992 and 2000. The mean age was 71 years ; 26 patients were female, 4 were male. Thirteen patients (14 prostheses) were clinically and radiologically examined at follow-up ; 9 patients (10 prostheses) were questioned by telephone and their radiological records were studied. With a mean follow-up of 31 months, 92 % (22/24) were entirely satisfied with the operation. The mean Constant score for the 14 shoulders which were clinically evaluated at follow-up was 60/100. There was one failure, related with glenoid loosening. These findings are in line with the good short-term results previously reported with this prosthesis.

Glenoid notching is a well-known problem with the reversed prosthesis ; it may lead to implant failure. We noted such an image in 50 % of our patients. In several cases however, the radiological finding was more suggestive of osteophytic formation than of real bony erosion, an observation that has not been reported before. The image remained stable over time and did not lead to glenoid loosening within the time limits of the study.

Nevertheless, notching remains a concern with respect to the long-term survival of these implants which should therefore, in our opinion, be used only in elderly patients.

Whether improved technique or design modification can address this issue still has to be established.

INTRODUCTION

Massive rotator cuff ruptures are difficult to treat. For the younger population, several repair techniques, such as tendon transfers, have been described *(11)*.

For the older, less active patients, these techniques cannot be used. Difficult rehabilitation often leads to joint stiffness. Furthermore, in this group of patients, massive tears are often complicated by *rotator cuff arthropathy,* which needs a different treatment strategy.

Conservative treatment with an adapted physiotherapy program should be tried for several months. If this approach fails, surgery may be considered.

The least aggressive intervention is joint debridement, with or without tenotomy of the long biceps, as described by Walch *et al (15)*. This treatment gives good early results, but only has moderate ambitions for the long term.

Arthroplasty has been an eagerly studied subject for many years. The major problem is proximal displacement of the humerus owing to lack of an intact cuff pushing the head against the glenoid, wear of the superior rim and absence of tendon interposition *(13)*. After total joint replacement under such conditions, proximal displacement of the humerus increases the forces transmitted to the

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glenoid implant and thus leads to glenoid loosening. For this reason, many surgeons prefer hemiarthroplasty. Nevertheless, proximal displacement of the humerus also occurs after hemiarthroplasty, and sometimes leads to wear of the acromio-coraco-glenoid arch. Proponents of hemiarthroplasty will argue that this is well tolerated, and is not associated with clinical deterioration *(10)*.

Several authors have proposed to perform *reverse arthroplasty* : Gerard and Lannelongue *(5)* in 1973, Neer and Averill *(9)* and Kessel and Bayley *(1)* in the early eighties. The prosthesis used in this study, the Delta III™ marketed by DePuy, has been introduced by Grammont *(6)* in 1985. An important feature of this prosthesis is the medialisation and the distalisation of the centre of rotation in order to maximise the lever arm of the deltoid muscle.

The purpose of this study was to evaluate the results of this implant at short and middle term follow-up in the treatment of massive rotator cuff tears with cuff tear arthropathy.

MATERIAL AND METHODS

The glenoid component of the Delta III prosthesis is composed of the "metaglene" and the "glenosphere". The metaglene, covered with hydroxyapatite, is fixed with screws to the glenoid. The glenosphere, which is a half sphere, is fixed to the metaglene by a Morse taper and a central screw. The humeral component may be cemented or not, according to the surgeon's preference. A polyethylene insert is interposed between these two components.

Between 1992 and 2000, 32 prostheses were implanted in 30 patients for rotator cuff arthropathy by the same surgeon; 26 patients were female, 4 male. The mean age at the time of the operation was 71 years. Osteotomy of the acromion was performed in the first case in 1992, but all subsequent implantations were through an anterolateral approach without acromial osteotomy. The humeral component was cemented in all cases.

Three patients (with the first three implants) died since their operation. The first prosthesis, implanted in 1992, had a survival of 9 years and functioned very well until the patient's death.

All patients were invited for a clinical and radiological evaluation. Fourteen patients were not able to come for follow-up and their clinical and radiological records were studied. Five patients were lost to follow-up ; 9 patients (10 prostheses) were questioned by telephone. The following questions were asked :

- Are you satisfied with the operation ?
- Would you undergo the same operation if necessary ?
- How is your pain level ? none – mild – moderate – severe.
- Do you have pain at night / Does this pain affect your sleep ?
- Difficulties to sleep : none – minor – major.
- Difficulties to eat : none – minor – major.
- Difficulties to wash yourself : none – minor – major.

The patients who were re-examined for the study were evaluated using the Constant score *(2)* and had a radiological examination. On these films, we looked for signs of loosening and for the presence of a "glenoid notch", which is a bony erosion of the inferior rim of the glenoid (vide infra).

RESULTS

Thirteen of the 14 patients seen at the consultation are presented in table I.

Note that Constant scores of 60-70/100 are good for this aged population, especially as they have not been weighed against age and/or the contralateral shoulder. Many points are allocated to force and mobility, which may well be reduced even in "normal" patients at the age of 70-80.

The answers to the questionnaire are summarised in table II**.** All the patients would undergo the same operation on the contralateral side if needed. Except one patient, who presented glenoid loosening, all were fully satisfied with the intervention. One patient, who is not included in table I, sustained a fracture below the stem during a fall, 17 months after her arthroplasty (fig 1). She had a Constant score of 22/100 (pain 5 ; ADL 4 ; mobility 12 ; force 1). Despite this poor score and her limited function, she was satisfied with the operation. She had less pain than before the operation and would undergo the same intervention if needed.

One failure was noted in a man who underwent shoulder arthroplasty in 1998 for invalidating omarthrosis. The preoperative Constant score was 21/100 (pain 5 ; ADL 8 ; mobility 6 ; force 2). He was the only patient in whom a 42-mm epiphyseal component was implanted. The polyethylene insert

Table I. – Patients with their Constant scores

NAME	sex	age	follow -up (months)	notch (Nerot)	CONSTANT SCORE				
					pain /15	ADL /20	mobility /40	force /25	**TOTAL /100**
GG	M	76	50 m	grade 4	5	8	10	2	**25**
DR	F	72	48 m	grade 2	15	14	30	11	**70**
MG	F	85	47 m	grade 2	15	14	28	9	**66**
LM	F	66	41 m	grade 3	15	16	36	7	**74**
JN d	F	71	36 m	grade 2	15	16	26	5	**62**
MG	F	85	33 m	grade 1	10	14	28	9	**61**
NMF	F	55	31 m	grade 0	15	18	34	15	**82**
DL	F	74	26 m	grade 2	10	16	28	3	**57**
RY	F	73	20 m	grade 0	15	16	38	11	**80**
BJ	F	77	14 m	grade 3	10	10	18	2	**40**
RC	F	66	14 m	grade 0	10	12	28	9	**59**
JN g	F	71	12 m	grade 0	15	8	16	2	**41**
FJ	M	62	11 m	grade 2	10	16	30	9	**65**
MEAN		**72**	**29.5**	**-**	**12**	**14**	**27**	**7**	**60**

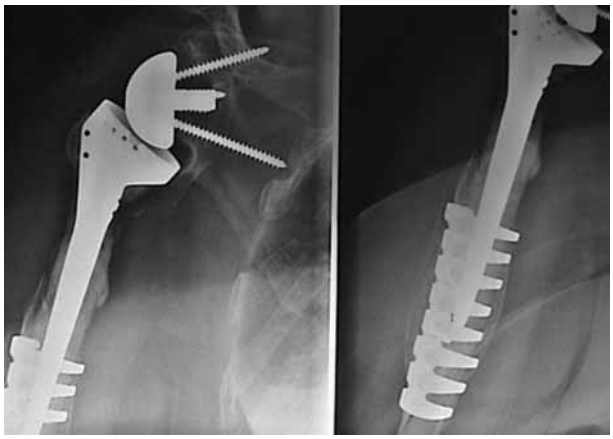

Fig. 1. — Radiographs of an 80-year-old female patient, 40 months after shoulder replacement and 23 months after a periprosthetic fracture.
Note the presence of a grade 2 glenoid notch.

had no offset. He did well for several years. Four years after his operation, he was still fully satisfied and had a score of 73/100 (pain 15 ; ADL 16 ; mobility 28 ; force 14). Progressively, pain and functional impairment returned and radiographs revealed glenoid loosening (fig 2).

The answers from the patients questioned by telephone are summarised in table III.

The mean follow-up of these 10 patients was 36 months.

One patient was not satisfied with her operation. She had no relief of her symptoms. She could not

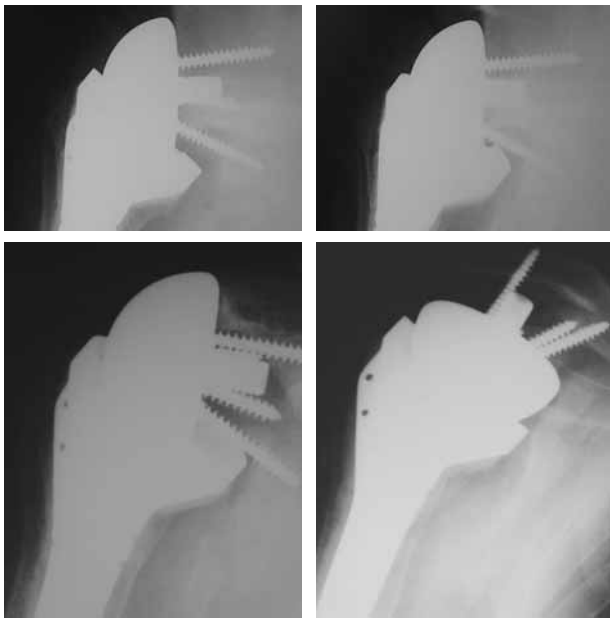

Fig. 2. — Radiographs at 4 months, 1, 4 and 5 years. A notch has developed rapidly. At one year the notch reaches the inferior screw (grade 3). At five years, glenoid loosening is evident (grade 4).

be re-examined, as she had moved abroad permanently.

The radiographic study did not show any radiolucent lines at the humerus. The presence of a glenoid notch was noted in several cases (fig 3). This has been reported in the literature and is considered to be the main problem of the prosthesis. Its origin

Table II. – Answers noted for the patients who were seen at the consultation

– Are you satisfied with the operation ? – 13/14 yes
– Would you undergo the same operation if necessary? – 14/14 yes
– Pain level : none – mild – moderate – severe. – 7/14 (50%) none – 5/14 (36%) mild – 2/14 (14%) moderate – 0/14 (0%) severe
– Do you have pain at night / Does this pain affect your sleep? – 11/14 (79%) normal – 3/14 (21%) difficult
– Difficulties to eat : none – minor – major. – 12/14 (86%) none – 2/14 (14%) minor – 0/14 (0%) major
– Difficulties to wash yourselves : none – minor – major. – 10/13 (77%) none – 2/13 (15%) minor – 1/13 (8%) major

Table III. – Answers noted for the patients questioned by telephone

– Are you satisfied with the operation ? – 9/10 yes
– Would you undergo the same operation if necessary ? – 9/10 yes
– Pain level : none – mild – moderate – severe. – 7/10 none – 2/10 mild – 1/10 moderate – 0/10 severe
– Do you have pain at night / Does this pain affect your sleep? – 9/10 normal – 1/10 difficult
– Difficulties to eat : none – minor – major. – 8/10 none – 2/10 minor
– Difficulties to wash yourselves : none – minor – major. – 8/10 none – 2/10 minor

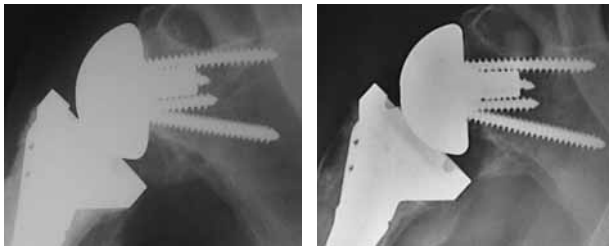

Fig. 3a. — Prosthesis at 4 and 25 months. Note the appearance of a notch that reaches the inferior screw. It can be classified as grade 3.

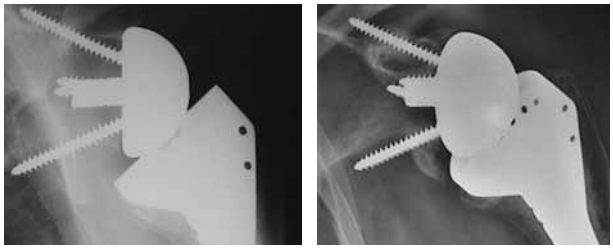

Fig. 3b. — Prosthesis at 1 and 50 months. A grade 3 notch is apparent.

remains debated ; two hypotheses have been proposed.

According to the first hypothesis, the notch is secondary to impingement of the medial border of the humeral implant against the inferior rim of the glenoid *(4,14)*. The second hypothesis suggests osteolysis secondary to polyethylene wear *(14)*. Delloye *et al* believe that the cause is purely mechanical and is not related to polyethylene debris, as osteolysis is always located at the same place and is not associated with adjacent osteopenia, but rather with reactive osteosclerosis *(4)*.

A classification of glenoid notching has been proposed by Nerot *(14)* (fig 4).

The occurrence and distribution of the various types of notches are presented in table IV.

In 50% of the cases, no notch was observed. However, the follow-up in this group is limited. In one case (cf. failure described above) glenoid notching progressed towards implant loosening.

Notches classified grade 2 are quite often more suggestive of a spur than of a bony erosion and suggest that there has been additional bone formation with sclerotic borders, rather than bone loss (fig 5).

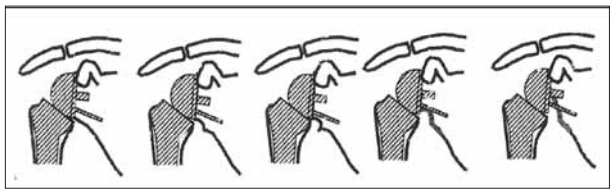

Fig. 4. — Classification of the notches by Nerot (14). Grade 0 : no notch ; grade 1 : small notch; grade 2 : notch with condensation (stable) ; grade 3 : evolutive notch (erosion of the inferior screw) ; grade 4 : loosening of the glenoid component.

DISCUSSION

The treatment of rotator cuff arthropathy is difficult. Until now no treatment has given entirely satisfactory results.

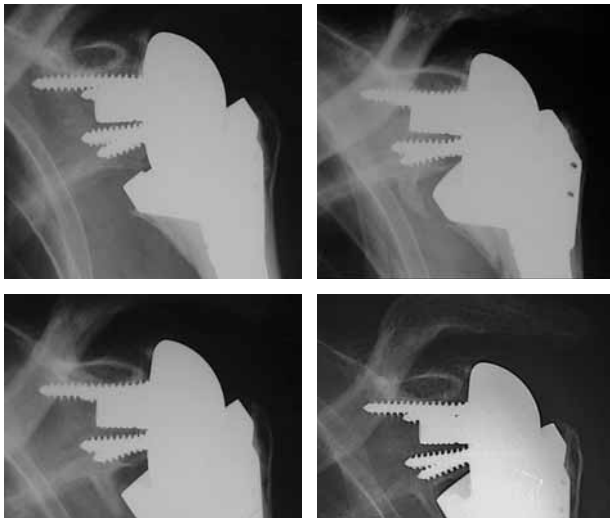

Fig. 5a. — Reversed prosthesis postoperatively, at 10 months, at 22 months and at 34 months. A notch appears already at 10 months. At 22 months the margin is dense, which corresponds with a Nerot grade 2. However, we have the impression that it's rather an 'osteophyte', than real bony erosion of the glenoid. This lesion appears to be stable in time.

In general the Grammont prosthesis provides spectacular pain relief. The patients experienced severe pain with limited function preoperatively and they regained a nearly painless shoulder with satisfactory function, considering their activity level. Of the 24 patients interviewed, 92% were entirely satisfied, only two – including the patient with failure – were not satisfied with the result.

Other authors reported similar good results. Sirveaux *et al (12)* had a satisfaction rate of 96% with a follow-up of 44.5 months. Valenti *et al (14)* noted improvement of the Constant score from 21 preoperatively to 63, seven years postoperatively, De Buttet *et al (3)* from 19.4 to 59, at 25 months and Jacobs *et al (8)* from 17.9 to 56.7 at 16 months.

The main problem remains the development of a glenoid notch. We observed such a notch in 50% of our cases, which is in line with other reports in the literature. Sirveaux *et al (12)* reported an incidence of 65% with a follow-up of 44.5 months and Valenti *et al (14)*, 86% at 7 years.

Notching led to loosening in one case in our series. Considering this, the outcome of grade 3 notches is a matter for concern.

In 17% of cases the notch was not a true bony erosion, but appeared more as a spur. Such an observation had not been reported in the literature until now. Whether it is a different expression of the same mechanism or results from another cause, is difficult to determine. This formation appears to be stable over time, and we do not think its progression would be likely to lead to glenoid loosening. In our opinion, it seems important to distinguish the two entities.

In order to reduce the risk for glenoid notching, technical solutions have been proposed. Since sev-

Table IV. – Distribution of the various types of notches noted on radiographs

Classification of notch	Number	Percentage	Mean follow-up
Grade 0	12	50 %	13 months
Grade 1	1	4%	33 months
Grade 2	6	25 %	
	4 'osteophytic lesion'	17 %	
	2 erosions	8 %	
			36 months
Grade 3	4	17 %	32 months
Grade 4	1	4 %	60 months

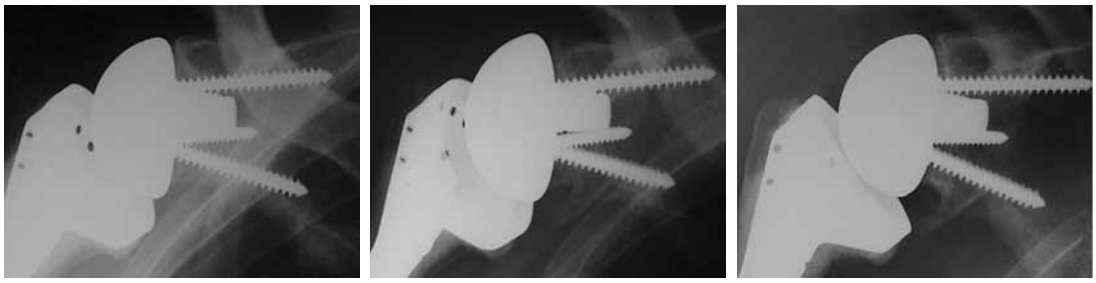

Fig. 5b. — Prosthesis at 2, 12 and 24 months. At one year we already see a notch with sclerotic margins (grade 2), which does not reach the inferior screw. We have the impression that it is rather an 'osteophyte'. The image is unchanged one year later.

eral years, the polyethylene insert always has an offset of + 6 mm, which increases the distance between the metal epiphysis and the glenoid. Furthermore, the metaglene is implanted as distally as possible. We think that the 42-mm implant should be avoided whenever possible. Respecting these guidelines seems to have reduced the development of notches in more recent cases.

Currently, several authors try to solve the problem by modifying the implant's geometry. The benefit from such changes remains however to be demonstrated.

CONCLUSION

The reverse shoulder prosthesis of Grammont is an excellent option in the treatment of rotator cuff arthropathy, with very satisfying and sometimes spectacular short-term results.

The development of a glenoid notch is worrisome for the long term. However, we think that two types of notches should be distinguished. In the case of a more "osteophyte-like" lesion, with additional bone formation rather than bony erosion, the outcome appears less worrisome.

Large series with long-term follow-up are needed to clarify the outcome of grade 3 notches. Improved technique and perhaps modification of the design could decrease the formation of these notches and increase the survival rate of this prosthesis, which has proven its qualities. Until then the prosthesis should be reserved for an older population.

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