



## Could intraoperative ultrasound improve clinical and radiological outcomes during arthroscopic calcification evacuation of rotator cuff?



Adrien Rossetti, MD<sup>a</sup>, Vincent Martinel, MD<sup>b</sup>, Thomas Raoul, MD<sup>c</sup>, Anthony Herve, MD<sup>c,\*</sup>

<sup>a</sup>Department of Orthopedic Surgery, Pontchaillou University Hospital of Rennes, Rennes, France

<sup>b</sup>Orthopedic Group Ormeau Pyrénées, Polyclinique de l'Ormeau, ELSAN, Tarbes, France

<sup>c</sup>Department of Orthopaedic Surgery, St Laurent Hospital, Rennes, France

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**Background:** Martinel et al described an intraoperative ultrasound technique to easier identify calcification (CA) under arthroscopy. Our hypothesis was that intraoperative ultrasound monitoring allowed better evacuation of calcific tendinopathy. Our aim was to determine whether ultrasound monitoring improved the short-term clinical and radiological outcomes of calcific tendinopathy.

**Methods:** A prospective, single-center, single-operator, consecutive study conducted between February 2020 and June 2023. The inclusion criterion was surgical treatment for evacuation of symptomatic macro-centimetric CA type A or B. The first 20 patients were operated on using the standard surgical technique and the next 20 under ultrasound control. The mean age at surgery was 49.8 years (minimum: 28 years; maximum: 64 years). Patients were reviewed at 6 weeks and 3 months. The evacuation of the CA was checked at 6 weeks by X-ray.

**Results:** In the standard technique group, the mean preoperative Constant score was 41.4/100 ( $\pm 15.07$ ). Postoperatively, the Constant score was 58.88/100 ( $\pm 15.28$ ) at 6 weeks and 69.16/100 ( $\pm 13.86$ ) at 3 months. The mean preoperative Subjective Shoulder Value (SSV) was 39.0% ( $\pm 18.61$ ). Postoperatively, the SSV was 64.0% ( $\pm 17.21$ ) at 6 weeks and 79.47% ( $\pm 16.06$ ) at 3 months. In the ultrasound control group, the preoperative Constant score was 44.48/100 ( $\pm 14.28$ ) and 58.18/100 ( $\pm 15.64$ ) at 6 weeks and 66.87/100 ( $\pm 18.45$ ) at 3 months postoperatively. The mean preoperative SSV was 40.0% ( $\pm 16.54$ ) and 61.75% ( $\pm 18.59$ ) at 6 weeks and 76.05% ( $\pm 19.62$ ) at 3 months postoperatively. There was no significant postoperative difference in Constant score ( $P = .732$ ) or SSV ( $P = .566$ ) between the 2 groups. There was a significant difference ( $P = .004$ ) between the 2 groups in terms of complete evacuation of the CA with the standard technique in 65% of cases (13 patients out of 20) and with intraoperative ultrasound monitoring in 95% of cases (19 patients out of 20).

**Conclusion:** There was no significant postoperative difference in Constant score and SSV between the 2 groups in the short term. Evacuation of calcification was significantly better with ultrasound monitoring.

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Calcific tendinopathy (CT) of the rotator cuff corresponds to a painful shoulder caused by one or more calcium deposits in the tendons of the cuff.<sup>2</sup> Its pathophysiology remains poorly understood. Arthroscopic evacuation of the calcification (CA) is the gold standard surgical treatment for CT after failure of well-managed medical treatment for 6 months.<sup>9</sup> The short- and long-term clinical outcomes of arthroscopic evacuation of the CAs are excellent.<sup>4–10</sup> Sabeti et al<sup>12</sup> were the first to describe a surgical technique with intraoperative ultrasound monitoring to identify more easily

CA and control that it was complete. This technique was improved by Martinel et al.<sup>8</sup>

The aim was to determine whether intraoperative ultrasound control improve clinical and radiological outcomes for arthroscopic CA evacuation.

Our hypothesis was that intraoperative ultrasound would provide better clinical and radiological outcomes than the reference technique.

### Material and methods

This was a prospective single-center single-operator consecutive study conducted between February 2020 and June 2023. The inclusion criterion was patients operated of a macro-centimetric CA (type

The Hospitalité St-Thomas de Villeneuve ethics committee approved this study.  
\*Corresponding author: Anthony Herve, MD, Department of Orthopaedic Surgery, St Laurent Hospital, 320 avenue du Général G. S. Patton, Rennes, 35700, France.

E-mail address: [drhervebuard@gmail.com](mailto:drhervebuard@gmail.com) (A. Herve).

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A or B) of the supraspinatus or the infraspinatus according to Molé and Francophone Society of Arthroscopy (SFA)'s classification.<sup>9</sup>

Noninclusion criteria were repair of a transfixing or partial rotator cuff tear, type C CAs and subscapularis CA.

The patients were divided into 2 groups, the first 20 patients were operated using the standard arthroscopy surgical technique and the next consecutive 20 patients with an intraoperative ultrasound control (Venus 50, General Electric, Boston, USA).

- Group 1: standard arthroscopy operating technique
- Group 2: intraoperative ultrasound control

### Surgical technique

The operation was performed in a beach chair position under general or locoregional anesthesia, depending on patients' wishes. The surgical technique was the same for both groups, with the only difference being the intraoperative ultrasound control of CA's evacuation. A glenohumeral exploration was not performed. The subacromial débridement was performed immediately with an electrocautery device. The coracoacromial ligament and subacromial bursitis were resected to have more space in the subacromial area to work. No acromioplasty was performed as recommended in CA type 1 or 2.

In group 1, a needle was used to pinch the tendon until the CA was found. Calcific debris were supposed to clear out from the tendon. Then, with a second lateral portal, the superficial layer of the tendon was opened with a surgical knife. By applying pressure on either side of the tendon incision, the CA was expelled and aspirated with a shaver until evacuation was as complete as possible under arthroscopic visual control.

In group 2, once the sterile drape was in place, before arthroscopic exploration, the CA was identified by ultrasound. An 18G needle was inserted percutaneously into the CA. (Fig. 1). Once the needle had been located, the scope was introduced laterally with a secondary lateral entry point. An anterolateral or posterolateral instrumental approach was used to complete the bursectomy and incised the tendon along the axis of its fibers with a scalpel blade. The evacuation of the CA continued with a shaver until any calcific debris remains. An ultrasound control was performed immediately after stopping the arthropump to ensure complete evacuation of the CA. If calcium residues persisted, the evacuation procedure was continued until ultrasound confirmed that the CA had been completely resected.

Patients were then immobilized in an analgesic sling with active and passive mobilization authorized from the outset.

### Clinical assessment

A total of 40 patients were included. No patient was lost to follow-up. The mean age at surgery was 49.8 years (minimum: 28.0 years; maximum: 64.0 years). All patients were reviewed at 6 weeks. We analyzed the Constant score<sup>4</sup> and the Subjective Shoulder Value (SSV)<sup>5</sup> preoperatively, at 6 weeks and at 3 months.

### Radiological assessment

Complete evacuation of the CA was controlled at 6 weeks with antero posterior radiographs and a lateral view of the shoulder.

### Statistical analyses

Statistical analyses were performed using EasyMedStat software (EasyMedStat, Levallois-Perret, France). Age between the 2 groups

was compared by a parametric Student's t test (S) and sex by a parametric  $\chi^2$  test (K). The Wilcoxon test was used to compare qualitative values and a Pearson correlation test for quantitative values.

An independent ethics committee has validated this study.

## Results

Preoperative epidemiological and clinical characteristics of the patients were presented in Table 1. The 2 groups were comparable in terms of age, sex, smoking status, tendon, and type of CA.

### Clinical outcomes

In group 1, the mean preoperative Constant score was 41.4/100 ( $\pm 15.1$ ). Postoperatively, the Constant score was 58.9 ( $\pm 15.3$ ) at 6 weeks ( $P < .001$ ) and 69.2 ( $\pm 13.9$ ) at 3 months ( $P = .001$ ). The mean preoperative SSV was 39.0% ( $\pm 18.6$ ). Postoperatively, the SSV was 64.0 ( $\pm 17.2$ ) at 6 weeks ( $P < .001$ ) and 79.5 ( $\pm 16.1$ ) at 3 months ( $P = .001$ ) (Fig. 2).

In group 2, the preoperative Constant score was 44.5/100 ( $\pm 14.3$ ). Postoperatively, the Constant score was 58.2 ( $\pm 15.6$ ) at 6 weeks ( $P = .013$ ) and 66.9 ( $\pm 18.5$ ) at 3 months ( $P = .001$ ). The mean preoperative SSV was 40.0% ( $\pm 16.5$ ), 61.7% ( $\pm 18.6$ ) at 6 weeks and 76.1% ( $\pm 19.6$ ) at 3 months postoperatively (Fig. 3).

There was no significant difference between the 2 groups preoperatively on the Constant score ( $P = .534$ ) and the SSV ( $P = .978$ ), and postoperatively (respectively  $P = .732$  and  $P = .566$ ). Any complication neither capsulitis was observed postoperatively.

### Radiological outcomes

There was a significant difference ( $P = .044$ ) between the 2 groups in terms of complete evacuation of the CA with the standard technique in 65% of cases (13 patients out of 20) and with intraoperative ultrasound control in 95% of cases (19 patients out of 20).

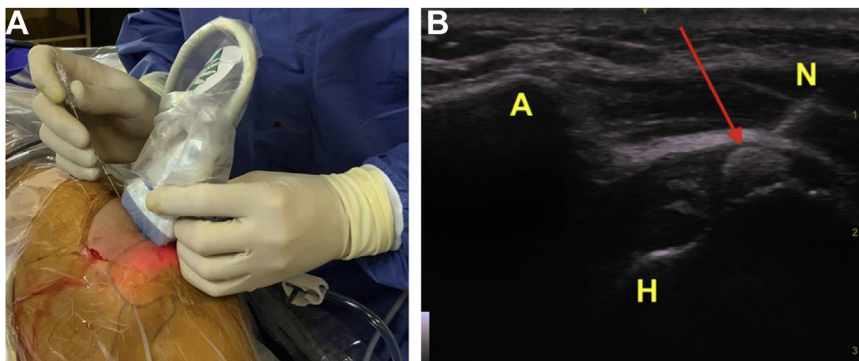
## Discussion

Our hypothesis was that intraoperative ultrasound control would improve the outcome of CA evacuations. Our aim was to determine whether ultrasound control was a factor which could improve the clinical and radiological outcomes of arthroscopic CA evacuation.

Our study showed that Constant score the SSV were significantly improved in the 2 groups at 6 weeks and 3 months but without statistical significance into the 2 groups. The radiological outcome was significantly better in the group with ultrasound monitoring.

Clinical scores have been reported to be lower in cases of failure to complete evacuation of CA.<sup>7</sup> Porcellini et al<sup>10</sup> used ultrasound (US) during the follow-up of 63 patients operated of CA evacuation to look for residual calcific micro-debris that would not have been seen on standard radiography. The persistence of calcific debris was significantly associated with a lower Constant score and was essentially linked to a higher pain item.

In 2014, Sabeti et al<sup>12</sup> reported in a prospective study with an intraoperative ultrasound control that the operating time was significantly decreased. Range of motion and pain were improved but there was no significant difference between the two groups. The radiographic follow-up was long (9 months) and didn't permit to assess the interest of US because the natural history of the CA was its spontaneous evacuation. In 2007, the SFA symposium<sup>3</sup> found intraoperative failure which meant that the CA was not found in 6.4% of the cases. CA was present in 62.1% of the cases. Some of the CA had disappeared because of the natural history of the disease.

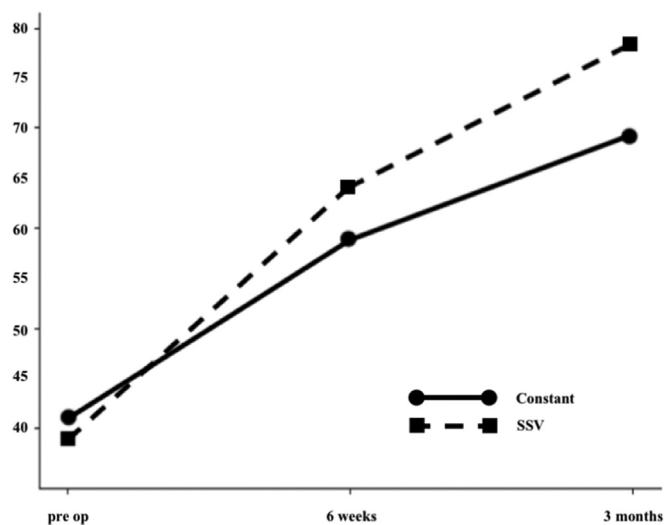


**Figure 1** (A) 52F, right shoulder, lateral position. Longitudinal arthroscopic ultrasound-guided needling. (B) Intraoperative ultrasound view of the shoulder ((→) = calcification; A = acromion; H = humeral head; N = needle).

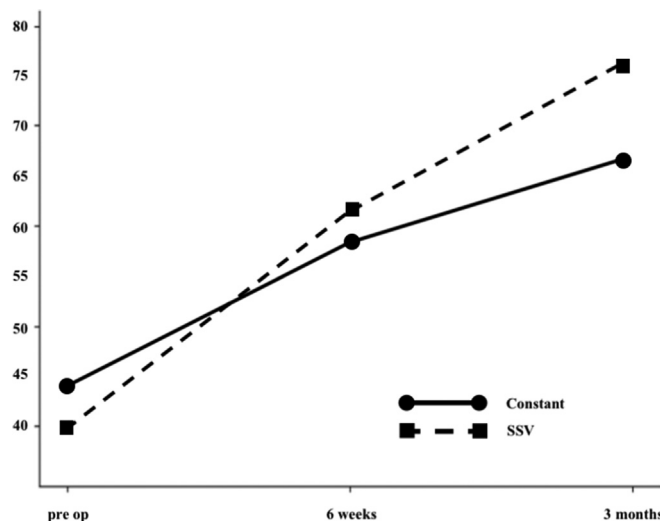
**Table 1**  
Characteristics of 40 patients (40 shoulders) who underwent calcification evacuation.

Characteristics	Overall (n = 40)	USM- (n = 20)	USM+ (n = 20)	P value
Age (y) m ± SD (range, min-max)	49.8 ± 8.66 (28.0-64.0)	52.3 ± 6.92 (43.0-64.0)	47.2 ± 9.62 (28.0-62.0)	.22
Sex, n				
Female	28	13	15	.49
Male	12	7	5	
Smoking status, n				
Yes	10	4	6	.47
No	30	16	14	
SFA classification, n				
A	11	6	5	.72
B	29	14	15	
Calcification location, n				
Supra	29	17	19	.092
Infra	9	2	7	
Supra + infra	1	0	1	
Subscap	1	1	0	

SD, standard deviation; SFA, Francophone Society of Arthroscopy; USM, ultrasound monitoring.



**Figure 2** Curves showing the evolution of the Constant score (round solid line) and SSV score (square dotted line), preoperatively, at 6 weeks and at 3 months in group 1, standard arthroscopic control. SSV, Subjective Shoulder Value.



**Figure 3** Curve showing the evolution of the Constant score (round solid line) and SSV score (square dotted line), preoperatively, at 6 weeks and at 3 months in group 2, the echo-arthroscopic control technique. SSV, Subjective Shoulder Value.

It can be difficult and time-consuming to locate the CA in the tendon by manual puncture with a needle. Fluoroscopic inspection is the gold standard for checking whether intratendinous calcific debris remain. However, the exposure to radiation and the amount of equipment in the operating room, in addition to the arthroscopy, encourage us to abandon this technique.

An antero posterior and a profile radiograph is usually performed a few days before the operation to check if the CA was still present.

In addition to preoperative rental of the CA, immediate intraoperative US monitoring after evacuation allows optimize the procedure for returning to the subacromial space in the event of incomplete evacuation.<sup>11,14</sup>

No capsulitis was observed postoperatively in either group. No intra-articular exploration was performed. Sirveaux et al,<sup>13</sup> showed that systematic glenohumeral exploration had a significant negative influence on the final outcomes ( $P < .01$ ).

The persistence of residual calcic deposits was not associated with capsulitis, confirming the results of the 1993 SFA symposium.<sup>9</sup>

The pathophysiology of CT is still poorly understood and is the subject of much research. Archer et al<sup>1</sup> put in evidence that CA corresponded to the accumulation of calcium crystals inside matrix vesicles within a fibro-cartilaginous metaplasia, in contact with chondrocyte-like cells with disappearance of tenocytes within the tendon.<sup>1</sup>

More recently, Grases et al<sup>6</sup> showed that the urine concentration of a mineralization-inhibiting enzyme phytate, was significantly lower in a population of patients with intratendinous CA than in a healthy population. This systemic enzyme deficiency could favor the development of CA in a context of local cellular metaplasia.

In our series, intraoperative ultrasound monitoring of evacuations did not show better outcomes than the standard technique, but evacuation of CA was significantly more effective in the case of ultrasound monitoring. Further multicenter studies with larger numbers will be needed to confirm these results and promote the use of ultrasound as the new gold standard for surgical evacuation of CA.

## Conclusion

The clinical outcomes were significantly improved at 6 weeks and 3 months but without statistical significance into the 2 groups. The radiological outcome was significantly better in the group with ultrasound monitoring which encouraged the authors to promote this technique as the new gold standard.

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