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ORIGINAL ARTICLE

Pain after shoulder arthroscopy: A prospective study on 231 cases

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Summary
Introduction: Shoulder arthroscopy is reputed to be painful, but progression of postoperative pain after this type of surgery has never been described and analyzed. This study had a triple objective: the description, search for risk factors, and analysis of the long-term impact of postoperative pain.
Patients and methods: This continuous prospective series includes 231 patients who underwent arthroscopic shoulder surgery. Pain was evaluated from D−1 to D3, then at D7, D30, and 1 year. Three pain criteria were noted: visual analog scale (VAS), morphine intake, and satisfaction with pain management. Surgery was performed under general anesthesia and/or interscalene block. A local anesthetic complement was administered in one of four modes: single subacromial injection, subacromial catheter, intra-articular catheter, or no complement.
Results: The VAS values remained less than 4 out of 10 during the entire study. Immediate postoperative pain was less than preoperative pain. It was followed by a pain bounce on D1 and D2 and did not return to a level significantly lower than its preoperative value until D30. Rotator cuff repair is the most painful surgery in the first postoperative days. The main risk factor for pain is a work related accident or occupational disease, associated with higher VAS values from D1 to 1 year and greater morphine intake. There was no correlation between immediate postoperative and 1-year VAS values.
Discussion, conclusion: Pain after shoulder arthroscopy is relatively low and the efficacy of the intervention is long-lasting in terms of pain symptom. A pain bounce appears on D1, which must be taken into account, notably in the context of outpatient surgery. The use of local anesthesia is therefore advantageous. Despite the efficacy of postoperative pain relief protocols, their effect on longer term perspective was not demonstrated.
Level of evidence: Level IV. Descriptive cohort study.
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Introduction

The question of postoperative pain after shoulder arthroscopy is essential. Although it seems clear that it conditions patient comfort and satisfaction, controlling pain is a prerequisite for an outpatient practice, which is tending to be generalized in all centers specialized in shoulder arthroscopy.

Therefore, pain must be described precisely and yet, although shoulder arthroscopy is reputed to generate less postoperative pain than open surgery, to our knowledge, no study has described pain during the first days after this intervention. The only publications available have compared the pain results of arthroscopic and open surgery procedures [1,2] at the 30th or at best the 7th postoperative day.

The search for the causes and risk factors of pain should complete the description, allowing the surgeon to anticipate the pain result as early as the preoperative consultation and within the patient's context. Moreover, this adds a nearly medicolegal dimension to informing the patient.

Finally, the short-, intermediate-, and long-term consequences of postoperative pain are poorly known. Some have suggested an influence on the functional result [3], but no study has been able to determine whether taking pain and its treatment into account is important only for the patient's immediate and early postsurgical comfort or whether it also influences the final result.

The aims of this study were therefore to respond to three queries: precisely evaluate the postoperative pain after the main indications of shoulder arthroscopy, confirm or invalidate some of its causes and risk factors, and finally identify its long-term symptomatic consequences by analyzing the correlation between postoperative pain and results at 1 year.

Patients and methods

Study design

This is a prospective continuous study including all patients undergoing shoulder arthroscopy in our center for any indication between January and May 2007.

Evaluation criteria

Three pain evaluation criteria were retained: visual analogic scale (VAS), daily and total morphine intake, and patient satisfaction on pain management during follow-up.

To take into consideration the differences in morphine antalgics' route of administration, the daily and total intakes were converted into equivalent dose of oral morphine before comparison. The following formulas were used for conversion: 1 mg subcutaneous = 2 mg equivalent oral morphine; 1 mg intravenous = 3 mg equivalent oral morphine.

The data were recorded twice daily from the day before surgery until the 3rd postoperative day. During hospitalization, the data were recorded by the medical or paramedical staff. After discharge, a questionnaire was given to the patients, who returned it once completed on the 30th postoperative day.

Table 1 General characteristics of the patients included in the study.

Sex	
Female	118
Male	82
Age (years)	56.1
Duration of pain (years)	2.5
Work accidents and occupational diseases	53 (26.5%)
Side	
Right (64%)	
Dominant (%)	61
Nondominant (%)	3
Left (36%)	
Dominant (%)	4
Nondominant (%)	32
History of shoulder surgery	55 (27.5%)
Same side	9
Opposite side	46

At 1 year, the patients were seen in consultation with a follow-up X-ray. A last VAS value was collected, and, due to the use of local peri- or intra-articular anesthesia, the patients were systematically checked for chondrolysis.

Population studied

During the 5 months of patient recruitment, 241 patients were retained. Ten of these were excluded because they did not understand the questionnaire and the principle of the VAS. This study therefore included 231 patients, whose characteristics are summarized in Table 1.

All arthroscopies were performed in a classical nonoutpatient context and this study responded to a need to organize a systematic outpatient practice for the future.

Anesthetic and analgesic methods

Two different anesthetic procedures were implemented, alone or in association: general anesthesia (GA) and preoperative interscalene block (ISB). No clear consensus appeared in the literature: the preferential indications of GA or ISB depended on the surgeon's and anesthesiology team's preferences.

In addition, aiming for postoperative antalgesia, three complementary ''surgical'' techniques were available to the operator at the end of the intervention:

- placement of a subacromial catheter connected to an elastomeric pump delivering 10 ml/h of ropivacaine 2% for 30 h;
- placement of an identical catheter in an intra-articular position;
- a single injection in the subacromial space of 20 ml of ropivacaine 2%.

No consensus exists to date and the operator's choice could be made based on any of the techniques or none of them [4—9].

Table 2   Distribution of anesthetic and analgesic methods.

	Number of patients (% of total)
Anesthetic methods	
General anesthesia alone (GA)	196 (84.9)
Interscalene block alone (ISB)	22 (9.5)
GA + ISB	13 (5.6)
Complementary analgesic methods	
Single injection of ropivacaine	125 (54.1)
Glenohumeral catheter	14 (6.1)
Subacromial catheter	44 (19.1)
None	48 (20.8)

It should also be noted that although GA only plays a purely anesthetic role for the duration of the operation, this is not the case of ISB, which also plays a role in immediate postoperative pain relief. ISB is therefore considered in this study both an anesthetic procedure and an analgesic method.

The distribution of the anesthetic and analgesic methods used are reported in Table 2.

Surgical methods

In the 231 patients, the arthroscopies were distributed into four types depending on the procedure:

- repair in cases of rotator cuff repair, no matter what other procedures were associated;
- decompressive when at least one of the following procedures was performed without rotator cuff repair: acromioplasty, acromioclavicular resection, calcifying tendinitis removal, bicipital intervention (tenotomy or tenodesis);
- instability in cases of anterior stabilization;
- other arthroscopic procedures.

The details of the data, notably from the ''other arthroscopic procedures'' group are summarized in Table 3.

Postoperative care was standardized depending on the type of intervention. Patients with instability were immobilized in a vest-type shoulder sling for 4 weeks; decompressive arthroscopy patients were placed in a simple sling for 2 weeks and mobilized beginning the next day with self-rehabilitation guided by a physical therapist; after rotator cuff repair, immobilization depended on the size of the rupture, from a simple sling with self-rehabilitation to immobilization to a 4-week immobilization with a thoracobrachial abduction orthosis.

Results

General population

The VAS recordings over the follow-up period for the entire population are illustrated in Fig. 1. Generally, the VAS values remained under 4 out of 10.

Table 3   Types of arthroplasty and interventions.

	Number
Type of arthroscopy	
Decompressive	122
Repair	78
Instability	20
Other	11
Type of intervention	
Rotator cuff repair	78
Calcifying tendinopathy	31
Acromioplasty	164
Acromioclavicular resection	27
Bicipital intervention	91
Tenotomy	53
Tenodesis	38
Anterior stabilization	20
Other procedure	11
Exploration (including one with total prosthesis)	4
Glenohumeral arthrolysis	3
Ablation of osteosynthesis material	1
SLAP	1
Neurolysis of suprascapular nerve	1
Shrinkage	1

The sum of the interventions performed was greater than the total number of patients because several procedures were most often associated during the same arthroscopy.

As for immediate postoperative pain at H1 and H3, the VAS values (respectively, 2.5 and 2.2) were lower than those noted preoperatively (2.9) but with no statistical correlation.

Every day until D30, the mean VAS value was statistically different from the preceding day. The mean VAS on D0 (2.2) was lower than the preoperative VAS value. Similarly, on D1 and D2 a pain bounce was observed compared to the day of surgery, with VAS at 2.8 and 3.3, respectively. On D7 the mean VAS (2.6) did not differ from the preoperative VAS value (2.9); on D30 and at 1 year, the VAS value was significantly lower, with respective values of 2.2 and 1.2.

Total morphine intake reached 8.2 mg in oral morphine dose equivalent. More than 50% of the morphine was admin-
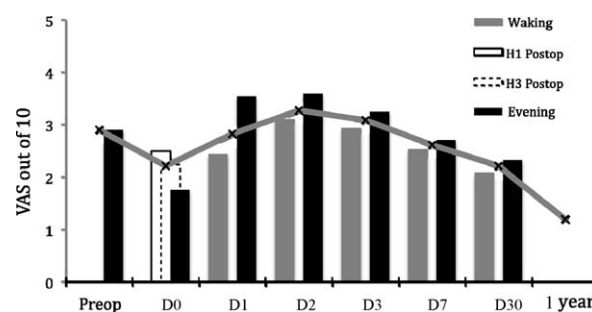

Figure 1   Daily VAS values (histogrammes) and means (curve). Until D30 there was a statistically significant difference between all the successive mean VAS values. Compared to preoperative VAS values, the difference was also statistically significant on D30 and at 1 year.
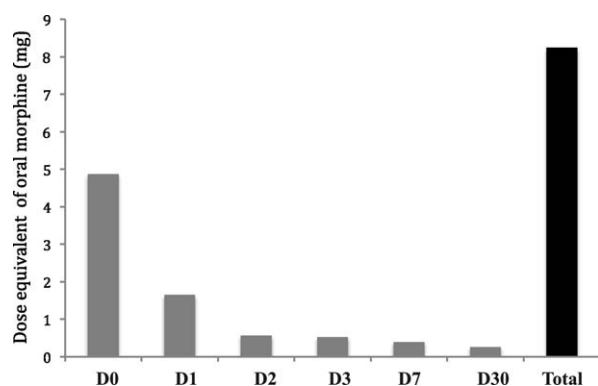
Figure 2   Daily and total consumption of morphine.

istered the day of surgery and rapidly decreased until the end of follow-up (Fig. 2).

In terms of satisfaction with pain management during follow-up, 83.9% of the patients were satisfied or very satisfied and 16.1% little or not at all satisfied.

Finally, none of the follow-up X-rays at 1 year showed signs of chondrolysis.

Type of arthroscopy

Only the three following types of arthroscopy were compared: decompressive, repair, and instability. We did not include ''other arthroscopic procedures'' here, which were too few in number for statistical tests and had a high level of diversity.

Given that the patients had not been randomized, distribution of the analgesic techniques used depending on the type of arthroscopic procedure was not homogenous (Table 4).

Two types of results are presented to compare the pain results: perioperative VAS recordings and mean daily VAS recordings (Fig. 3a and 3b).

Preoperatively, the patients who experienced the most pain statistically speaking were those who were operated on for a decompressive arthroscopy procedure (VAS = 3.5), followed by repair arthroscopic procedures (VAS = 2.6), and then instability procedures (VAS = 1.0).

During the entire immediate postoperative period until the morning of D1, the repair arthroscopy patients experienced the highest level of pain (VAS H1 = 3.8; H3 = 3.2; evening = 2.3), followed by instability patients (VAS H1 = 2.5;
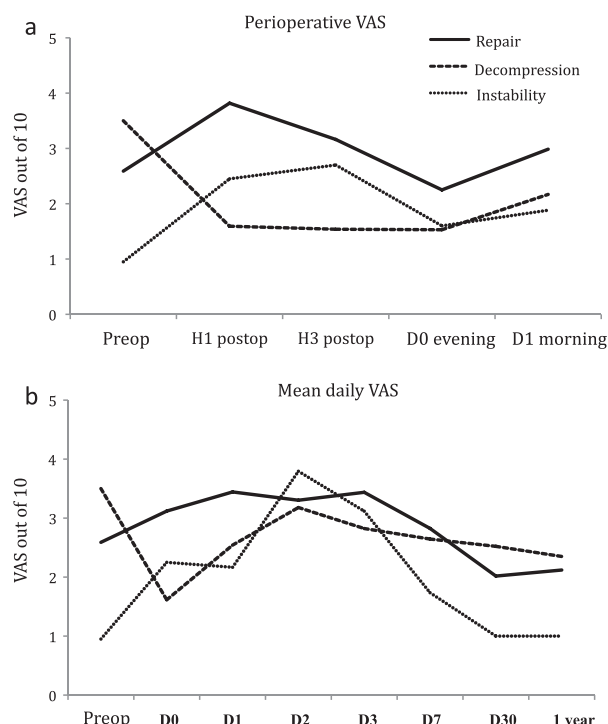

Figure 3   Changes in VAS; a (top): Changes in VAS during the perioperative period (preoperative to morning of D1); b (bottom): Changes in mean daily VAS values during entire follow-up period.

H3 = 2.7; evening = 1.6, and decompression patients (VAS H1 = 1.6; H3 = 1.5; evening = 1.5).

On D1, the mean daily VAS values were significantly higher for the repair arthroscopy patients (3.4) than for the other types (2.5 for decompression patients and 2.2 for instability patients).

All VAS differences disappeared from D2 to D30.

At 1 year, within each group, the VAS values were not statistically different from their D30 value (with 2.1 and 2.0 for repair arthroscopy, 2.4 and 2.5 for decompression, and 1.0 and 1.0 for instability, respectively). However, compared to preoperative pain, the VAS value at 1 year was statistically lower only in the decompressive arthroscopy group (3.5 and 2.4, respectively).

In terms of morphine intake, the progression pattern for each type of arthroscopy procedure was similar to the general population's pattern (Fig. 4). The highest intake was in

Table 4   Distribution of anesthetic and analgesic methods by type of arthroscopic procedure.

Anesthetic and analgesic method	Type of arthroscopic procedure		
	Repair	Decompression	Instability
ISB	6	25	1
Subacromial catheter	41	2	0
Glenohumeral catheter	12	0	0
Injection	19	93	12
None	3	9	7

The sum of the interventions performed was greater than the total number of patients because several procedures were most often associated during the same patient.
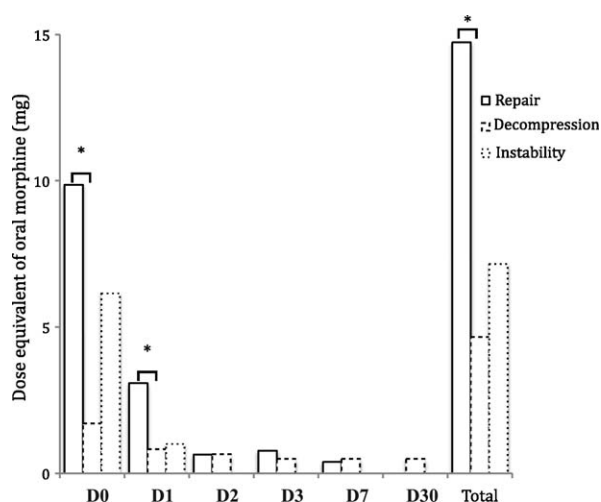
Figure 4 Daily and total consumption of morphine by type of arthroscopy. *: $P < 0.05$.

the repair arthroscopy group, which was statistically significant compared to decompressive arthroscopy patients on D0, D1, and in total (respective intake: 9.9 and 0.8 mg on D0; 3.1 and 0.8 mg on D1; 14.7 and 4.7 mg in total).

Analgesic technique

Preoperatively, there was no difference in VAS between the four analgesic possibilities: 3.8 for ISB, 2.7 for the subacromial catheter, 3.4 for the single subacromial injection, and 1.2 in absence of additional analgesia.

At postoperative H1 and H3, the ISB was associated with significantly lower VAS values (respectively, 1.0 and 0.8) than with the three other methods (4.4 and 3.4 for the subacromial catheter; 2.0 and 2.0 for the single subacromial injection; 1.7 and 1.4 in absence of analgesic complement).

On D0 and D1, the VAS values were statistically significantly higher in patients with a subacromial catheter (three VAS recorded at 2.5—5.0) than in the other patients (three VAS recordings, 1.4—3.4 for the ISB; 1.6—3.0 for the single subacromial injection; 2.0—3.4 in absence of analgesic complement).

From D2 until the end of the follow-up, no difference in VAS was observed in the four groups.

In terms of painkiller use, morphine intake was greater on D0 and D1 in patients who had a subacromial catheter with 12.7 mg and 4.0 mg doses, respectively.

Finally, there was no difference in satisfaction between the four pain relief techniques used.

Risk factors

Risk factors for pain were sought among the general characteristics of the population, as shown in Table 1. Age, duration and progression of pain, side involved, and patient's history of shoulder surgery were not associated with higher levels of pain in the overall population.

However, sex and professional context were statistically associated with higher pain.

Female patients had a higher preoperative VAS value (0.6 points) than male patients. Postoperatively, this trend was inverted and males experienced greater pain than females, with higher VAS values by 0.6—0.8 on D0. There was no longer a difference starting with D1.

A work accident or occupation-related disease was a risk factor for higher postoperative pain from D1 to 1 year, with statistically higher VAS values by 1—1.3 points compared to the other patients, whereas there was no difference in preoperative VAS values between these groups.

These same risk factors were also investigated within the three types of arthroscopic procedures studied. Only the professional context was statistically associated with an increase in pain, throughout the follow-up period in the group of decompressive arthroscopy patients, and only at 1 year in the group of repair arthroscopy patients.

Finally, a search for a VAS correlation between the preoperative and immediate postoperative levels, the preoperative and 1-year levels, and the immediate postoperative and 1-year levels showed no statistically significant relation between these values.

Discussion

This study establishes the pain profile from the first hours to the 30th day postoperative after shoulder arthroscopy. It demonstrates that a good pain control is generally obtained after this type of surgery, maintaining the mean VAS under 4 out of 10. Contrary to its reputation, this surgery is not among the most painful of the main orthopaedic interventions. For example, after total hip arthroplasty D0 VAS ranges from 5.1 and 5.6 and from 4.1 to 5.1 on D1. After total knee arthroplasty, the VAS at D0 and D1 reaches 5.4. Even when rotator cuff repair is performed, the most painful arthroscopic procedure, pain is less [10,11].

Over the longer term, only on D30 and not before does VAS become less than its preoperative level and this efficacy with regard to pain is maintained at 1 year.

More specifically, on D0, appropriate pain management makes it possible to obtain a lower VAS than its preoperative value. This management is highly present the day of surgery, as attested by the morphine dose that is administered on this day up to more than 50% of the total intake. However, one must nonetheless take the pain bounce on D1 and D2 into consideration. We explain this bounce by a lower administration of morphine beginning on D1 and by the effect of ending any locoregional anesthetic administered (ISB in the present study).

This pattern of pain (low pain on D0, bounce on D1—D2, and persistent improvement of pain from D30) can be applied to the three types of arthroscopy: repair, decompressive, and instability. However, the pain levels differ greatly among these three groups. Instability procedures were the least painful before surgery and remained so on D30. Decompressive arthroscopy evolved symmetrically with the highest VAS values before surgery and on D30, with the surgery involving little pain. Rotator cuff repair turns out to be the most painful intervention during the perioperative period, with the highest dose of morphine administered.

The search for risk factors for postoperative pain confirms the negative effects of work accidents and occupational diseases, particularly in decompressive arthroscopic surgery

after which pain is greater over both the short and long terms.

One of the objectives of this study was to determine the short-, medium-, and long-term effect of postoperative pain relief: is this a (legitimate) preoccupation limited to the patient's comfort during the perioperative and early postoperative periods or is there a real impact on the progression of the pathology over the longer term? In this study, we observed no correlation between the VAS levels on D0 and 1 year. This does not argue for managing postoperative pain influencing the long-term result, but we can nonetheless recognize that only more aggressive management of postoperative pain relief would have established this relation, absent in this study.

The analgesic techniques used in this study may be a potential bias even if the objective was not to assess any of the different methods available. We could have concluded in the three following trends:

- superiority of ISB compared to the other techniques;
- uselessness of the single subacromial local injection, which was no different from abstention;
- absence of efficacy of the subacromial catheter, associated with higher VAS values, including when compared to abstention.

Given the study's methodology and objectives, these trends are no more than an indication and in no way statistically significant. Furthermore, certain analgesic techniques seem to have been preferentially used in certain indications (subacromial catheter for rotator cuff tears, single subacromial injection for decompression and instability). Only a comparative randomized study can conclude in the superiority of one technique over the others.

Finally, whatever procedures are performed or analgesic techniques implemented, there was no effect in terms of patient satisfaction on pain management throughout the follow-up.

All these data are essential to separate out patients before surgery and to determine the management mode that is best adapted to their situation. In view of performing the highest number of arthroscopies possible in the outpatient context, it is mandatory to identify those that must be excluded because of risk factors or the type of surgery planned.

In addition, knowing that a pain bounce occurs on D1 and D2 requires finding solutions because this is the main factor of failure of outpatient surgery. Beyond systematically prescribing painkillers of sufficient efficacy for the days following discharge, a solution can be placing a preoperative perineural catheter connected to an elastomeric pump delivering a continuous flow of local painkiller, as has been reported several times [12—14].

These local or locoregional anesthetic techniques should be used with caution, however. In recent publications, several cases of postarthroscopic glenohumeral chondrolysis have been described [15—17], whose cause may have been the use of local peri- or intra-articular anesthetics, as several animal model studies have suggested [18,19]. In the present study, this complication was systematically sought in all patients and no cases were found.

Conclusion

Shoulder arthroscopy produces little pain and its efficacy in terms of pain is long-lasting.

Even if the surgical and anesthetic techniques provide good pain control the day of surgery, a pain bounce appears on D1 that must be taken into account, notably in an outpatient setting.

Risk factors and surgical indications at risk for postoperative pain have been identified and these patients should receive particular attention. In this perspective, the further extended use of locoregional anesthesia methods should be envisaged.

Finally, we have demonstrated no relation between postoperative pain and the result at 1 year.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

[1] Barfield LC, Kuhn JE. Arthroscopic versus open acromioplasty: a systematic review. Clin Orthop Relat Res 2007;455:64—71.
[2] Buess E, Steuber KU, Waibl B. Open versus arthroscopic rotator cuff repair: a comparative view of 96 cases. Arthroscopy 2005;21:597—604.
[3] Cameron B, Galatz L, Williams Jr GR. Factors affecting the outcome of total shoulder arthroplasty. Am J Orthop 2001;30:613—23.
[4] Banerjee SS, Pulido P, Adelson WS, Fronek J, Hoenecke HR. The efficacy of continuous bupivacaine infiltration following arthroscopic rotator cuff repair. Arthroscopy 2008;24:397—402.
[5] Beaudet V, Williams SR, Tetreault P, Perrault MA. Perioperative interscalene block versus intra-articular injection of local anesthetics for postoperative analgesia in shoulder surgery. Reg Anesth Pain Med 2008;33:134—8.
[6] Boss AP, Maurer T, Seiler S, Aeschbach A, Hintermann B, Strebel S. Continuous subacromial bupivacaine infusion for postoperative analgesia after open acromioplasty and rotator cuff repair: preliminary results. J Shoulder Elbow Surg 2004;13:630—4.
[7] Ciccone 2nd WJ, Busey TD, Weinstein DM, Walden DL, Elias JJ. Assessment of pain relief provided by interscalene regional block and infusion pump after arthroscopic shoulder surgery. Arthroscopy 2008;24:14—9.
[8] Singelyn FJ, Lhotel L, Fabre B. Pain relief after arthroscopic shoulder surgery: a comparison of intraarticular analgesia, suprascapular nerve block, and interscalene brachial plexus block. Anesth Analg 2004;99:589—92 [table of contents].
[9] Tetzlaff JE, Brems J, Dilger J. Intraarticular morphine and bupivacaine reduces postoperative pain after rotator cuff repair. Reg Anesth Pain Med 2000;25:611—4.
[10] Ranawat AS, Ranawat CS. Pain management and accelerated rehabilitation for total hip and total knee arthroplasty. J Arthroplasty 2007;22:12—5.
[11] Parvataneni HK, Shah VP, Howard H, Cole N, Ranawat AS, Ranawat CS. Controlling pain after total hip and knee arthroplasty using a multimodal protocol with local periarticular injections: a prospective randomized study. J Arthroplasty 2007;22:33—8.
[12] Krone SC, Chan VW, Regan J, Peng P, Poate EM, McCartney C, et al. Analgesic effects of low-dose ropivacaine for interscalene brachial plexus block for outpatient shoulder

surgery-a dose-finding study. Reg Anesth Pain Med 2001;26: 439—43.

[13] Ilfeld BM, Morey TE, Wright TW, Chidgey LK, Enneking FK. Continuous interscalene brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. Anesth Analg 2003;96:1089—95 [table of contents].

[14] Fredrickson MJ, Ball CM, Dalgleish AJ. Successful continuous interscalene analgesia for ambulatory shoulder surgery in a private practice setting. Reg Anesth Pain Med 2008;33:122—8.

[15] Anakwenze OA, Hosalkar H Huffman GR. Case reports: two cases of glenohumeral chondrolysis after intraarticular pain pumps. Clin Orthop Relat Res 2010;468(9):2545—9, http://www.ncbi.nlm.nih.gov/pubmed/20112077.

[16] Busfield BT, Romero DM. Pain pump use after shoulder arthroscopy as a cause of glenohumeral chondrolysis. Arthroscopy 2009;25:647—52.

[17] Hansen BP, Beck CL, Beck EP, Townsley RW. Postarthroscopic glenohumeral chondrolysis. Am J Sports Med 2007;35: 1628—34.

[18] Gomoll AH, Kang RW, Williams JM, Bach BR, Cole BJ. Chondrolysis after continuous intra-articular bupivacaine infusion: an experimental model investigating chondrotoxicity in the rabbit shoulder. Arthroscopy 2006;22:813—9.

[19] Gomoll AH, Yanke AB, Kang RW, Chubinskaya S, Williams JM, Bach BR, et al. Long-term effects of bupivacaine on cartilage in a rabbit shoulder model. Am J Sports Med 2009;37: 72—7.