Radiology

Do Patients with Structural Abnormalities of the Shoulder Experience Pain after MR Arthrography of the Shoulder?[1]

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Purpose: To assess the pain course after intraarticular injection of a gadolinium-containing contrast material admixed with anesthetic for magnetic resonance (MR) arthrography of the shoulder in relation to internal derangements of the shoulder.

Materials and Methods: Institutional review board approval and informed consent were obtained for this study. The study sample consisted of 655 consecutive patients (249 female, 406 male; median age, 54 years) referred for MR arthrography of the shoulder. Pain level was measured at baseline, directly after intraarticular injection of the gadolinium-containing contrast material admixed with anesthetic, 4 hours after injection, 1 day (18–30 hours) after injection, and 1 week (6–8 days) after injection with a visual analog scale (range, 0–10). MR arthrography was used to assess the following internal derangements: lesions of the rotator cuff tendons and long biceps tendon, adhesive capsulitis (frozen shoulder), fluid in the subacromial bursa, labral tears, and osteoarthritis of the glenohumeral joint. History of shoulder surgery was recorded. Linear regression models were calculated for the dependent variable (difference between follow-up pain and baseline pain), with the independent variable grouping adjusted for age and sex.

Results: There was no significant association between pain level over time and internal derangements of the shoulder, nor was there significant association between pain level over time in patients with a history of shoulder surgery and patients without a history of shoulder surgery.

Conclusion: Neither internal derangements nor prior surgery have an apparent effect on the pain course after MR arthrography of the shoulder.

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Magnetic resonance (MR) arthrography of the shoulder is accurate in the assessment of internal derangements of the glenohumeral joint. In contrast to conventional MR imaging, MR arthrography of the shoulder requires intraarticular injection of a gadolinium-containing contrast material, which may cause discomfort in patients (1–4). Administration of local anesthetics with the contrast medium may affect symptoms. However, knowledge of the time course and factors that influence pain and discomfort after intraarticular injection of contrast material for MR arthrography may help referring physicians and radiologists adequately inform patients about the procedure. Data on the relationship between pain resulting from MR arthrography and internal derangements of the shoulder are sparse (5–7). The purpose of our study was to assess the 1-week pain course after intraarticular injection of gadolinium-containing contrast material admixed with an anesthetic for MR arthrography of the shoulder in relation to internal derangements of the shoulder.

Materials and Methods

This prospective study was approved by the institutional review board responsible for our institution. All patients gave informed written consent.

This study population represents a subgroup of 1085 patients from another study (4) performed at our institution in which the authors assessed pain and side effects after MR arthrography of various joints. In 675 of these patients, MR arthrography of the shoulder was performed between May 2006 and May 2007. Patients who had undergone repeated MR arthrography of the same shoulder at different time points (n = 12) and patients who had undergone MR arthrography of both shoulders on the same day with no separate pain level assessment (n = 8) were excluded. This resulted in 655 patients (406 male, 249 female; median age, 54 years; age range, 17–82 years). The median age in the male group was 52 years (age range, 18–81 years). The median age in the female group was 55 years (age range, 17–82 years). The Wilcoxon test showed no significant difference in age between the groups (P = .06). A total of 124 (18.9%) patients underwent shoulder surgery before MR arthrography (87 male patients, 37 female patients; median age, 55 years; age range, 17–78 years).

Arthrography Technique

The injections were performed by 12 radiologists (four senior staff radiologists [J.H., M.Z., C.W.A.P.], 5–20 years of experience; three fellows training in musculoskeletal radiology [N.S.], 1–3 years of experience; five radiology residents [I.S.], >3 months of experience in musculoskeletal radiology, including joint injections). A 2¾-inch-long 20-gauge (0.9 × 70-mm) needle was advanced vertically to the upper third of the medial part of the humeral head with fluoroscopic guidance. Mepivacaine hydrochloride (Scandicain 2%; AstraZeneca, Södertälje, Sweden) was used to anesthetize the skin and joint capsule (0.8 mL ± 0.6 [standard deviation]), as well as the joint space (0.9 mL ± 0.4). To verify the intraarticular needle position, small amounts (1.1 mL ± 0.6) of iopamidol (200 mg of iodine per milliliter, Iopamiro 200; Bracco Suisse, Mendrisio, Switzerland) were injected. Subsequently, 9.7 mL ± 1.1 of 2 mmol/L gadopentate dimeglumine (Magnevist; Bayer Schering Pharma, Berlin, Germany) was administered (Fig 1).

MR Imaging

MR images were acquired with one of three 1.5-T systems (Symphony, Avanto, or Espree; Siemens Medical Solutions, Erlangen, Germany). The standard imaging protocol included a coronal oblique intermediate-weighted fat-saturated fast spin-echo sequence (repetition time msec/echo time msec, 2000/13; field of view, 160 × 100 mm; matrix, 512 × 256; section thickness, 4 mm; one signal acquired; turbo factor, 7), a coronal oblique T1-weighted fat-saturated fast spin-echo sequence (667/12; field of view, 160 × 100 mm; matrix, 512 × 256; section thickness, 3 mm; one signal acquired; turbo factor, 3), a sagittal oblique T2-weighted fat-saturated fast spin-echo sequence (3500/79; field of view, 160 × 100 mm; matrix, 512 × 256; section thickness, 4 mm; one signal acquired; turbo factor, 11), a sagittal oblique T1-weighted spin-echo sequence (531/12; field of view, 160 × 100 mm; matrix, 512 × 256; section thickness, 4 mm; one signal acquired), and a transverse true fast imaging with steady-state precession sequence (11.98/5.15; field of view, 180 × 87.5 mm; matrix, 512 × 256; section thickness, 1.7 mm; one signal acquired). For patients with a history of shoulder surgery, the sagittal oblique

Advances in Knowledge

- Patients with and those without MR evidence of internal derangements of the shoulder have a similar pain course after intraarticular injection of contrast medium admixed with local anesthetic.
- For patients who had a history of shoulder surgery, no adverse effect on the pain course after intraarticular injection of contrast medium was found.

Implications for Patient Care

- The fact that the pain course after contrast medium and local anesthetic injection may not be related to the presence of an internal derangement of the shoulder or the patient's postoperative status may be reassuring for patients and referring physicians.

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T2-weighted fat-saturated fast spin-echo sequence and the true fast imaging with steady-state precession sequence were replaced by the sagittal oblique turbo inversion-recovery magnitude sequence (4800/26; field of view, 160 × 100 mm; matrix, 512 × 256; section thickness, 3 mm; one signal acquired; turbo factor, 7) and the transverse T1-weighted spin-echo sequence (450/12; field of view, 160 × 100 mm; matrix, 512 × 256; section thickness, 3 mm; one signal acquired), respectively.

MR Imaging Findings

The first author (I.S.) reviewed the reports of all 655 MR arthrographic examinations and recorded all abnormalities. In accordance with institutional policy, reports were dictated and signed by the radiologist who performed MR arthrography and by a senior staff radiologist if the injection was performed by a resident or fellow.

The following internal derangements were recorded: Concerning the rotator cuff tendons (supraspinatus, infraspinatus, subscapularis) and the long head of the biceps tendon, degeneration and partial and full thickness tears were rated abnormal. The presence of fluid in the subacromial bursa, tears of the glenoid labrum, and osteoarthritis of the glenohumeral joint were also rated abnormal.

Pain Level Assessment

Pain levels were assessed at five time points by using a visual analog scale that ranged from 0 to 10 (0, no pain; 10, maximal pain) (8). Pain levels were assessed before (baseline) and directly after the injection for MR arthrography by the technician assisting the radiologist with the procedure. Pain level 4 hours, 1 day (18–30 hours), and 1 week (6–8 days) after the injection was assessed by one of two receptionists during a telephone interview.

Statistical Analysis

For each of the grouping variables, data were presented as a plot of the means per group. To assess the effect of grouping, we computed linear regression models for each of the postbaseline time points (directly after arthrography, 4 hours after arthrography, 1 day after arthrography, 1 week after arthrography), as well as for the dependent variable (pain at the given time point minus pain at baseline) and the independent grouping variable. All models were adjusted for age and sex. The various shoulder derangements were tested separately. We divided the patients into three mutually exclusive groups: those with an abnormality, those who did not have any internal derangement of the shoulder at MR arthrography (n = 53), and all others (those with at least one derangement but not the derangement being evaluated). The influence of the three-level grouping variable was assessed by using an F test to compare *(a)* the model with the respective variable with *(b)* the model without the respective variable. We have provided 95% confidence intervals for the effect estimates for the separate groups to give readers an idea about the effect sizes. All tests and confidence intervals were computed with a significance level of α = .05. All analyses were performed with R software (version 2.9.2 2009; Development Core Team, Vienna, Austria).

Figure 1

Figure 1: Fluoroscopic image obtained at injection of contrast medium for MR arthrography of the shoulder. Injection site (arrow) is the upper inner quadrant of the humeral head.

Results

The mean pain level in all patients before the injection (baseline level) was 2.5 (range, 0–10) on the visual analog scale. Immediately after injection, the pain decreased to a mean level of 2.3 (range, 0–10). The mean pain level was 3 (range, 0–10) 4 hours after injection, representing a slight increase in the pain level in comparison with the baseline pain level (+0.5) and the pain level immediately after injection (+0.7). The mean pain level decreased to 2.8 (range, 0–10) 1 day after the injection. One week after the injection, the mean pain level returned to 2.5 (range, 0–10); this was the same pain level as before the injection (baseline level).

MR Imaging Findings

The number of patients with derangements of internal structures of the shoulder joint at MR imaging and the number of patients with at least one derangement of the shoulder joint but not the one being tested are shown in Table 1. Of the 655 patients, 53 (8.1%) did not have any internal derangement in the shoulder joint. Structures that could not be evaluated (mostly because

Figure 2

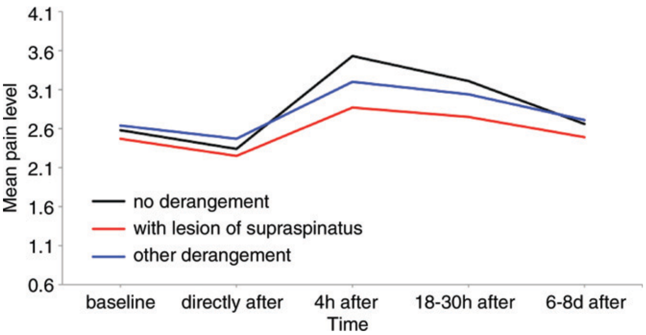

Figure 2: Graph shows mean pain scores at baseline and at four time points after injection.

Figure 3

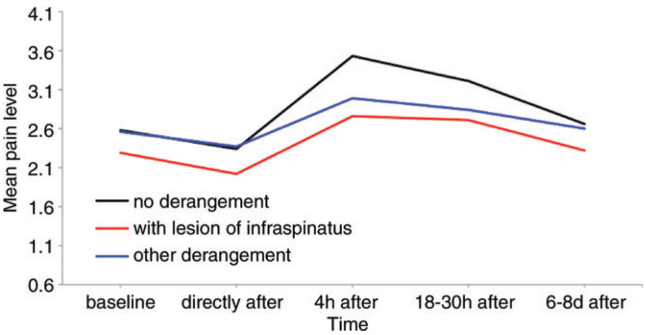

Figure 3: Graph shows mean pain scores at baseline and at four time points after injection.

Figure 4

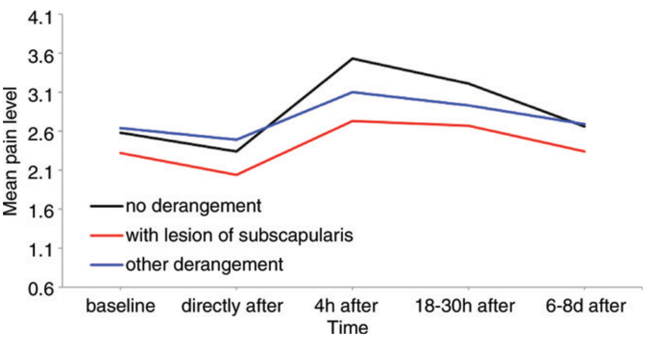

Figure 4: Graph shows mean pain score at baseline and at four time points after injection.

Figure 5

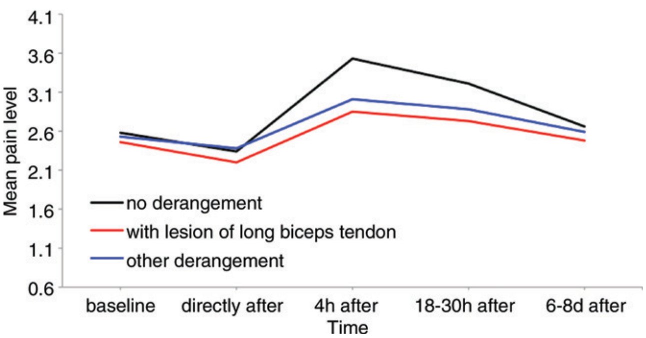

Figure 5: Graph shows mean pain score at baseline and at four time points after injection.

Table 1

Patients with Internal Derangements of the Shoulder and Patients with at Least One Derangement of the Shoulder but Not of the Structure Being Tested

Internal Derangement	Patients with the Derangement	Patients with Another Derangement	Not Applicable
Supraspinatus tendon	469 (71.7)	132 (20.2)	1
Infraspinatus tendon	126 (19.2)	476 (72.7)	0
Subscapularis tendon	257 (39.2)	345 (52.7)	0
Long biceps tendon	271 (44.4)	287 (43.8)	44
Frozen shoulder	49 (7.5)	553 (84.4)	0
Fluid in subacromial bursa	386 (58.9)	216 (33.0)	0
Tear of glenoid labrum	142 (21.9)	455 (69.5)	5
Osteoarthritis of the glenohumeral joint	60 (9.2)	541 (82.7)	1
Surgery before MR arthrography	124 (18.9)	478 (73.0)	0

Note.—Data are numbers of patients. Data in parentheses are percentages.

of artifacts due to movement or metallic implants) were not considered applicable, and the corresponding patients were omitted from analyses of these structures.

Association of Pain Course with Internal Derangements

For each of the variables (internal structures) tested, the mean pain course after intraarticular contrast material injection for MR arthrography is shown in Figures 2–9. In addition, the mean pain course for patients who had undergone shoulder surgery before MR arthrography is shown in Figure 10.

Pain Level at Baseline

Patients with lesions of the supraspinatus tendon (Fig 2), infraspinatus tendon (Fig 3), subscapularis tendon (Fig 4), or long biceps tendon (Fig 5), as well as those with labral tears (Fig 8) or glenohumeral osteoarthritis (Fig 9), had a slightly lower mean pain level than did patients with no internal derangement at baseline. Patients with MR findings consistent with frozen shoulder (Fig 6) or fluid in the subacromial bursa (Fig 7) and those who had undergone shoulder surgery before MR arthrography had more pain than did patients without such findings at baseline.

Pain Course after Injection

The F test revealed no significant influence on the pain course for any internal

Figure 6

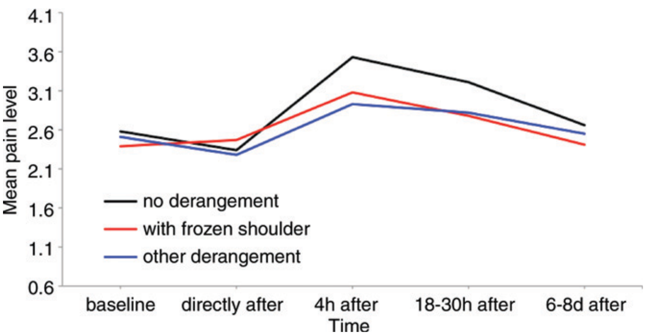

Figure 6: Graph shows mean pain score at baseline and at four time points after injection.

Figure 7

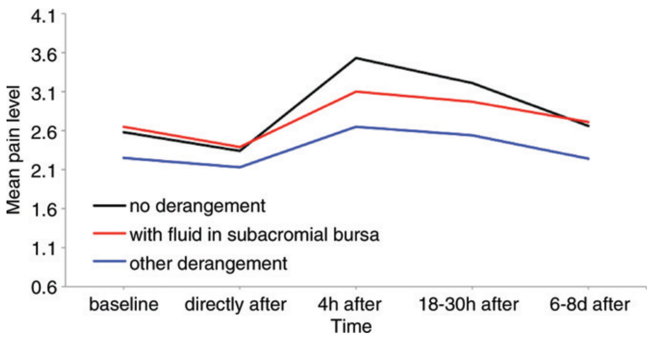

Figure 7: Graph shows mean pain score at baseline and at four time points after injection.

Figure 8

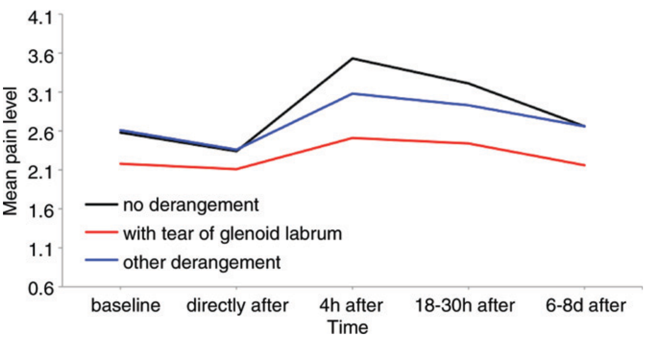

Figure 8: Graph shows mean pain score at baseline and at four time points after injection.

Figure 9

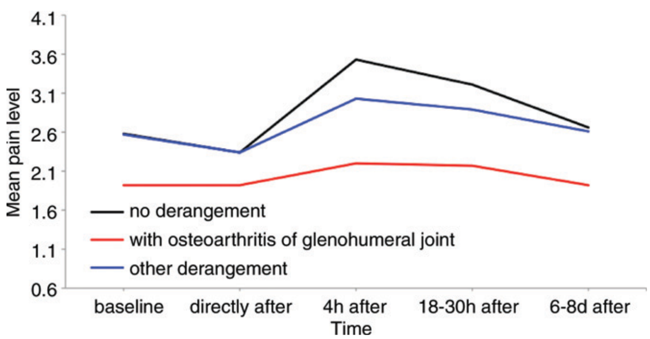

Figure 9: Graph shows mean pain score at baseline and at four time points after injection.

Figure 10

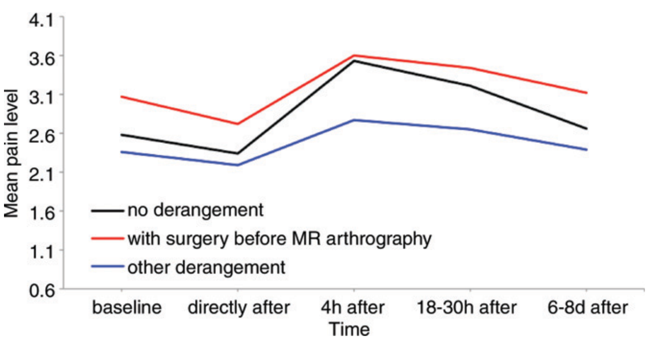

Figure 10: Graph shows mean pain score at baseline and at four time points after injection.

derangement after MR arthrography of the shoulder at any time point after intraarticular injection (Tables 2–5). The 95% confidence intervals for the effect estimates for the separate groups are provided in Tables 2–5. All models were adjusted for age and sex. These calculations revealed a few significant influences on the pain level after injection for MR arthrography of the shoulder. The confidence intervals for all the effect estimates were altogether narrow (they varied by less than 0.9 on the visual analog scale).

Association of Pain Course with History of Surgery

Of the 655 patients, 124 (18.9%) had undergone shoulder surgery before MR arthrography. Although patients with a history of surgery had slightly more pain at all time points, the pain course after MR arthrography in these patients was not significantly different from that of patients who had not undergone prior surgery. The 95% confidence intervals for the effect estimates for the separate groups are provided in Tables 2–5. All models were adjusted for age and sex. Women had a significantly lower increase in pain than did men ($P = .02$; 95% confidence interval: −0.46, −0.05).

Discussion

MR arthrography of the shoulder is useful in the evaluation of internal derangements of the glenohumeral joint. Compared with conventional MR imaging,

Table 2

Analysis of Covariance Directly after Injection

		Derangement Present		Other Derangement Present		Age		Sex	
Internal Derangement	F Test *P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value
Supraspinatus lesion	.771	0.145 (−0.252, 0.543)	.473	0.132 (−0.287, 0.551)	.536	−0.007 (−0.015, 0.0009)	.084	−0.241 (−0.445, −0.037)	.021
Infraspinatus lesion	.757	0.112 (−0.351, 0.576)	.634	0.142 (−0.244, 0.527)	.472	−0.007 (−0.014, 0.001)	.108	−0.243 (−0.447, −0.039)	.020
Subscapularis lesion	.528	0.066 (−0.354, 0.486)	.758	0.163 (−0.226, 0.552)	.411	−0.006 (−0.014, 0.002)	.153	−0.249 (−0.454, −0.045)	.017
Long biceps tendon lesion	.682	0.119 (−0.310, 0.548)	.586	0.168 (−0.232, 0.568)	.409	−0.007 (−0.015, 0.001)	.111	−0.203 (−0.418, 0.013)	.066
Frozen shoulder	.184	0.440 (−0.078, 0.959)	.096	0.116 (−0.270, 0.502)	.554	−0.007 (−0.014, 0.0006)	.071	−0.243 (−0.446, −0.039)	.019
Tear of glenoid labrum	.549	0.211 (−0.212, 0.635)	.328	0.105 (−0.292, 0.501)	.604	−0.006 (−0.014, 0.001)	.118	−0.232 (−0.439, −0.025)	.028
Osteoarthritis of the glenohumeral joint	.261	0.387 (−0.119, 0.893)	.134	0.127 (−0.258, 0.513)	.517	−0.008 (−0.015, 0.0001)	.053	−0.236 (−0.440, −0.032)	.024
Fluid in subacromial bursa	.469	0.087 (−0.313, 0.486)	.669	0.198 (−0.204, 0.600)	.333	−0.006 (−0.014, 0.002)	.124	−0.242 (−0.446, −0.038)	.020
Previous surgery	.177	−0.033 (−0.465, 0.400)	.882	0.190 (−0.199, 0.579)	.338	−0.007 (−0.015, 0.0005)	.066	−0.255 (−0.458, −0.050)	.015

Note.—Data in parentheses are 95% confidence intervals, adjusted for age and sex. The baseline for grouping and sex were no derangement and male, respectively.

Table 3

Analysis of Covariance 4 Hours after Injection

		Derangement Present		Other Derangement Present		Age		Sex	
Internal Derangement	F Test *P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value
Supraspinatus lesion	.147	−0.392 (−0.786, 0.002)	.051	−0.308 (−0.724, 0.107)	.146	−0.007 (−0.014, 0.001)	.095	0.167 (−0.035, 0.370)	.105
Infraspinatus lesion	.108	−0.235 (−0.694, 0.224)	.315	−0.368 (−0.751, 0.014)	.059	−0.009 (−0.016, −0.0006)	.035	0.177 (−0.025, 0.379)	.086
Subscapularis lesion	.172	−0.345 (−0.762, 0.072)	.105	−0.369 (−0.755, 0.017)	.061	−0.008 (−0.015, 0.0003)	.061	0.173 (−0.030, 0.376)	.094
Long biceps tendon lesion	.185	−0.373 (−0.786, 0.040)	.076	−0.346 (−0.731, 0.040)	.079	−0.008 (−0.016, 0.0003)	.060	0.228 (0.020, 0.436)	.032
Frozen shoulder	.058	−0.102 (−0.616, 0.413)	.698	−0.385 (−0.768, −0.001)	.049	−0.007 (−0.015, 0.0001)	.054	0.170 (−0.0031, 0.372)	.098
Tear of glenoid labrum	.075	−0.480 (−0.899, −0.061)	.025	−0.327 (−0.719, 0.066)	.103	−0.007 (−0.015, 0.0003)	.059	0.153 (−0.052, 0.358)	.144
Osteoarthritis of the glenohumeral joint	.134	−0.485 (−0.987, 0.018)	.059	−0.359 (−0.742, 0.024)	.066	−0.007 (−0.014, 0.0007)	.076	0.170 (−0.033, 0.372)	.100
Fluid in subacromial bursa	.126	−0.320 (−0.716, 0.076)	.113	−0.410 (−0.809, −0.011)	.044	−0.008 (−0.015, −0.0002)	.044	0.172 (−0.030, 0.374)	.096
Previous surgery	.120	−0.275 (−0.705, 0.155)	.209	−0.389 (−0.775, −0.002)	.049	−0.007 (−0.015, 0.0004)	.063	0.178 (−0.025, 0.380)	.085

Note.—Data in parentheses are 95% confidence intervals, adjusted for age and sex. The baseline for grouping and sex were no derangement and male, respectively.

Table 4

Analysis of Covariance 18–30 Hours after Injection

		Derangement Present		Other Derangement Present		Age		Sex	
Internal Derangement	F Test *P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value
Supraspinatus lesion	.180	−0.299 (−0.627, 0.028)	.073	−0.204 (−0.549, 0.141)	.247	−0.007 (−0.014, 0.001)	.631	0.167 (−0.035, 0.370)	.140
Infraspinatus lesion	.074	−0.063 (−0.448, 0.321)	.746	−0.255 (−0.576, 0.065)	.118	−0.009 (−0.016, −0.0006)	.155	0.177 (−0.025, 0.379)	.130
Subscapularis lesion	.163	−0.167 (−0.516, 0.183)	.350	−0.273 (−0.596, 0.050)	.098	−0.008 (−0.015, 0.0003)	.220	0.173 (−0.030, 0.376)	.131
Long biceps tendon lesion	.324	−0.270 (−0.623, 0.083)	.134	−0.221 (−0.551, 0.109)	.189	−0.008 (−0.016, 0.0003)	.361	0.228 (0.020, 0.436)	.152
Frozen shoulder	.276	−0.171 (−0.603, 0.261)	.437	−0.254 (−0.576, 0.067)	.121	−0.007 (−0.015, 0.0001)	.349	0.170 (−0.031, 0.372)	.157
Tear of glenoid labrum	.240	−0.303 (−0.654, 0.049)	.092	−0.241 (−0.570, 0.088)	.151	−0.007 (−0.015, 0.0003)	.412	0.153 (−0.052, 0.358)	.207
Osteoarthritis of the glenohumeral joint	.295	−0.295 (−0.717, 0.127)	.170	−0.248 (−0.569, 0.073)	.130	−0.007 (−0.014, 0.0007)	.389	0.170 (−0.033, 0.372)	.155
Fluid in subacromial bursa	.275	−0.225 (−0.557, 0.108)	.185	−0.274 (−0.608, 0.061)	.108	−0.008 (−0.015, −0.0002)	.312	0.172 (−0.030, 0.374)	.155
Previous surgery	.238	−0.185 (−0.545, 0.176)	.314	−0.266 (−0.591, 0.058)	.107	−0.007 (−0.015, 0.0004)	.371	0.178 (−0.025, 0.380)	.142

Note.—Data in parentheses are 95% confidence intervals, adjusted for age and sex. The baseline for grouping and sex were no derangement and male, respectively.

Table 5

Analysis of Covariance 6–8 Days after Injection

		Derangement Present		Other Derangement Present		Age		Sex	
Internal Derangement	F Test *P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value	Estimate of Change in Pain Level	*P* Value
Supraspinatus lesion	.180	−0.299 (−0.627, 0.028)	.073	−0.204 (−0.549, 0.141)	.247	−0.002 (−0.008, 0.005)	.631	0.127 (−0.041, 0.295)	.140
Infraspinatus lesion	.074	−0.063 (−0.448, 0.321)	.746	−0.255 (−0.576, 0.065)	.118	−0.005 (−0.011, 0.002)	.155	0.131 (−0.038, 0.300)	.130
Subscapularis lesion	.163	−0.167 (−0.516, 0.183)	.350	−0.273 (−0.596, 0.050)	.098	−0.004 (−0.011, 0.002)	.220	0.131 (−0.039, 0.301)	.131
Long biceps tendon lesion	.324	−0.270 (−0.623, 0.083)	.134	−0.221 (−0.551, 0.109)	.189	−0.003 (−0.010, 0.0004)	.361	0.130 (−0.048, 0.308)	.152
Frozen shoulder	.276	−0.171 (−0.603, 0.261)	.437	−0.254 (−0.576, 0.067)	.121	−0.003 (−0.009, 0.003)	.349	0.122 (−0.047, 0.292)	.157
Tear of glenoid labrum	.240	−0.303 (−0.654, 0.049)	.092	−0.241 (−0.570, 0.088)	.151	−0.003 (−0.009, 0.004)	.412	0.111 (−0.061, 0.282)	.207
Osteoarthritis of the glenohumeral joint	.295	−0.295 (−0.717, 0.127)	.170	−0.248 (−0.569, 0.073)	.130	−0.003 (−0.009, 0.003)	.389	0.123 (−0.047, 0.293)	.155
Fluid in subacromial bursa	.275	−0.225 (−0.557, 0.108)	.185	−0.274 (−0.608, 0.061)	.108	−0.003 (−0.010, 0.003)	.312	0.123 (−0.046, 0.292)	.155
Previous surgery	.238	−0.185 (−0.545, 0.176)	.314	−0.266 (−0.591, 0.058)	.107	−0.003 (−0.009, 0.003)	.371	0.127 (−0.042, 0.297)	.142

Note.—Data in parentheses are 95% confidence intervals, adjusted for age and sex. The baseline for grouping and sex were no derangement and male, respectively.

MR arthrography may improve diagnostic performance in the detection of shoulder abnormalities (9–16). Discomfort and pain after intraarticular injection of MR contrast media are concerns for both patients and physicians and have been discussed by several authors (1,3–7,17–19). Although patients tend to overestimate the discomfort related to arthrography before the procedure (3), knowledge of the factors that influence discomfort and pain during and after MR arthrography is of interest.

Administration of a local anesthetic to the shoulder capsule and glenohumeral joint probably has an effect on the pain course after injection for MR arthrography. The median duration of local anesthesia in this study (mepivacaine hydrochloride) is 1.5–3 hours. This could explain why the highest pain scores were noted up to 4 hours after the anesthetic had been administered. At that time, most of the local anesthesia would have worn off.

A few other factors, such as the influence of different injection sites and techniques, have already been analyzed (7,18). In one study, the difference between pain during intraarticular injection for MR arthrography when researchers compared the anterior approach with the posterior approach (both approaches used ultrasonographic [US] guidance) was not significant (18). In a recently published article, the pain level immediately after injection was found to be significantly higher with the anterior fluoroscopically guided approach than with the anterior US-guided approach or the posterior US- or fluoroscopically guided approach (7). However, the injection site for the anterior fluoroscopically guided approach was the middle medial third of the humeral head, while the injection site for the US-guided approach was the upper medial third of the humeral head. In all these studies, the time course after injection was not described.

Radiologist experience and the volume of injected contrast material have also been studied, but no substantial influence on the pain course has been found (4). Local anesthesia of the skin probably does not affect postprocedural pain (4,6).

There is controversy as to whether sex is a factor in pain course after intraarticular injection. In one study in which the pain level before, directly after, and 2 weeks after conventional arthrography of the shoulder was compared with the pain level at the same time points after conventional MR imaging, women reported more pain than did men at all stages for both investigations (2).

In our study, we found that women had a significantly smaller increase in pain than did men between baseline and the time directly after injection if they had lesions of the internal structures of the shoulder joint (except for lesions of the long biceps tendon) or if they had undergone shoulder surgery. At 4 hours after injection, there was also an influence of sex but only for the long biceps tendon—women had a higher increase in pain than did men. However, the 95% confidence intervals for the grouping variables are narrow and, in our opinion, they are not clinically relevant.

Age seems to play a role in the pain course. Patients younger than 30 years were reported to have increased pain levels after injection compared with older patients in a study in which pain levels in different joints after MR arthrography were analyzed (4). In our study, we could not find such an influence. However, the difference between pain at baseline and pain at the other time points was lower in older patients than in younger patients (estimated coefficient is always negative in all age groups). However, once again, the 95% confidence intervals were small.

Knowledge about the course of pain after diagnostic interventions is of clinical relevance. It may be reassuring for patients to have this information before the intervention.

During injection into the glenohumeral joint in a patient with frozen shoulder, resistance is often felt, and the patient often reports discomfort and pain. However, the pain expected after the procedure cannot be predicted. In our study, we did not find an association between the pain level over time and MR abnormalities of the shoulder. This means that patients with lesions of the rotator cuff or long biceps tendon, as well as those with frozen shoulder, fluid in the subacromial bursa, lesions of the glenoid labrum, or osteoarthritis of the glenohumeral joint, did not experience significantly more pain than did patients without such abnormalities. In one study (5), the authors found that patients with MR criteria of a frozen shoulder experienced significantly more pain and resistance during contrast material injection than did control subjects. However, the difference between pain before and pain during the injection was not assessed, and there was no follow-up to evaluate pain development over time. In our study, patients with frozen shoulder had a higher pain level before the injection and at all time points after the injection than did patients without the abnormality. The difference was small and not significant.

Our data did not allow us to confirm the hypotheses that patients with internal derangements at MR arthrography of the shoulder experience more pain after intraarticular injection of contrast material than do patients without such abnormalities.

Evaluation of patients with persistent problems after shoulder surgery is especially challenging. To know whether these patients are at greater risk of experiencing pain after MR arthrography than other patients is of interest. In our study, patients who had undergone shoulder surgery generally were found to have more pain before and after the procedure than did patients who had not undergone shoulder surgery; however, differences were not significant.

Our study had limitations. We did not evaluate whether the pain course after the injections depended on the type of physician (senior staff radiologist, junior staff radiologist, or resident) who performed the injection. However, in the prior study at our institution from which we got our subgroup population (4), the type of physician did significantly influence pain after MR arthrography of any of the joints tested.

In conclusion, we found that intraarticular injection of a gadolinium-containing contrast material admixed with an anesthetic did not have a significant effect on the pain course after MR arthrography of the shoulder in patients with internal derangements of the shoulder joint or a history of shoulder surgery.

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