



# Glenohumeral chondrolysis: A systematic review of 100 cases from the English language literature

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**Hypothesis:** Chondrolysis can be a devastating complication of shoulder arthroscopy. We undertook a review of the 100 cases reported in the English language to test the hypothesis that common factors could be identified and that the identification of these factors could suggest strategies for avoiding this complication.

**Materials and methods:** We systematically reviewed the English language literature and identified 16 articles reporting 100 shoulders in which postsurgical glenohumeral chondrolysis had developed.

**Results:** The average reported patient age was  $27 \pm 11$  years at the time of surgery; 35 were women. The most common indications for surgery were instability ( $n = 68$ ) and superior labrum anteroposterior lesions ( $n = 17$ ). In 59 cases, chondrolysis was reported to be associated with the use of intra-articular pain pumps. The infusate was known to include bupivacaine in 50 shoulders and lidocaine in 2. Radiofrequency capsulorrhaphy was performed in 2 shoulders.

**Discussion:** Fifty-nine percent of the reported cases of glenohumeral chondrolysis occurred with the combination of arthroscopic surgery and postarthroscopy infusion of local anesthetic. The arthroscopic operations observed with chondrolysis were not limited to stabilization procedures, and the infused anesthetic was not limited to bupivacaine.

**Conclusion:** In that postoperative infusion of local anesthetic and radiofrequency may not be essential to the success of shoulder arthroscopy, surgeons may wish to consider the possible risks of their use.

**Level of evidence:** Systematic Review

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**Keywords:** Chondrolysis; shoulder; glenohumeral; pain pump; arthroscopy

The term *chondrolysis* refers to the complete loss of a joint's articular cartilage as the result of the destruction of chondrocytes and dissolution of the cartilage matrix. Chondrolysis of the glenohumeral joint leads to

progressive, severe, and refractory loss of shoulder comfort and function.<sup>2,6,12-16,18,19,21-26,29,32,35-37</sup> Glenohumeral chondrolysis has been reported after relatively minor shoulder surgeries, especially arthroscopic surgery for instability.<sup>2,6,12-16,18,19,21-26,29,32,35-37</sup> It appears to be particularly prevalent when the procedure is combined with a number of different factors, including radiofrequency or laser capsulorrhaphy and the infusion of intra-articular local anesthetic after arthroscopy.<sup>3,6,14-16,18,23,24,30,34</sup> We

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systematically reviewed the English language literature on glenohumeral chondrolysis to help define some of the features common to reports of this devastating complication. We anticipated that this review would contribute to our understanding of this devastating condition and stimulate further investigation of its cause and prevention.

## Materials and methods

Approval from the Institutional Review Board (IRB #33869) at our institution was granted before we reviewed patient records.

## Literature search

We attempted to identify all articles describing cases of glenohumeral chondrolysis published in the English language literature before July 1, 2009. Search terms used with the PubMed search engine included *shoulder*, *glenohumeral*, and *chondrolysis*. Twenty-three articles were identified and reviewed,<sup>2,3,6,12-16,18,19,21-26,29,30,32,34-37</sup> and 16 were used in the literature review. Seven articles were excluded, comprising 3 reports of nonhuman basic science experiments,<sup>12,13,21</sup> 1 editorial,<sup>25</sup> 1 review article of previously published literature,<sup>22</sup> 1 case report related to a gunshot wound<sup>26</sup> and one case of idiopathic chondrolysis.<sup>19</sup> The 16 remaining articles reported 100 cases of glenohumeral chondrolysis in 95 patients. Three of the coauthors (P.T.S., J.C., J.R.L.) reviewed each of these articles, seeking patient demographics, presurgical diagnosis, findings at surgery, procedure performed, procedure details, postoperative pain pump usage, subsequent clinical course, radiographic findings, and findings at revision surgery.

## Data presentation

The information on the 100 shoulders in the literature is presented in Table I. The population from which these cases were derived is not known, so the frequency of the occurrence of chondrolysis cannot be estimated from these reports.

## Results

The information from the systematic literature review is summarized in Table I. Most of the arthroscopic surgeries were performed for instability or superior labrum anteroposterior tears. At the time of the index procedure, 6% of the shoulders had documented grade 1 and 2 chondral changes. Postoperative infusion of local anesthetics through a pain pump occurred in 59% of the shoulders with chondrolysis. The most common local anesthetic was bupivacaine, but lidocaine was used in 2 cases. Intra-articular radiofrequency probes were used in 34% of the shoulders, 28 for capsulorrhaphy and 6 for débridement. Eleven shoulders had both the use of radiofrequency intraoperatively and pain pumps postoperatively.

**Table I** Summary of clinical findings of literature review\*

| Variable   | Outcome                 |
|--|-------------------------|
| Shoulders, No.   | 100                     |
| Patients, No.  | 95                      |
| Males, No.†  | 42                      |
| Females, No.†  | 35                      |
| Age, y   |                         |
| Mean (SD)  | 27 (11.9)               |
| Range  | 13-64                   |
| Arthroscopic surgery, No.  | 96                      |
| Open surgery, No.  | 4                       |
| Instability procedures, No.  | 68                      |
| Bankart repairs for instability  | 30                      |
| Capsular plication for instability   | 38                      |
| Superior labrum anteroposterior repairs, No.   | 17                      |
| Rotator cuff repairs, No.  |                         |
| Open   | 4                       |
| Arthroscopic   | 1                       |
| Rotator cuff débridements, No  | 8                       |
| Capsular releases, No  | 4                       |
| Cases using suture anchors, No   | 63                      |
| Cases using radiofrequency, No   | 34                      |
| Radiofrequency capsulorrhaphies, No  | 28                      |
| Radiofrequency only for releases or débridements, No   | 6                       |
| Radiofrequency used in subacromial space only, No  | 0                       |
| Laser capsulorrhaphies, No   | 3                       |
| Intra-articular dye, No  | 4                       |
| Intra-articular pain pump, No  | 59                      |
| Bupivacaine in infusate, No. (concentration range)   | 50 (0.25%-2%)           |
| Lidocaine in infusate, No. (concentration range)   | 2 (unknown)             |
| Epinephrine in infusate, No. (concentration range)   | 19 (unknown)            |
| Flow rate range in cases where it was specified, mL/h  | 2-6.25                  |
| Days between arthroscopic surgery and symptoms onset, average (range)  | 254 (42-730)            |
| Days between arthroscopic surgery and radiographic diagnosis of chondrolysis   |                         |
| Average (SD)   | 307 (270)               |
| Range  | 90-1095                 |
| Cases reported, No.  | 35                      |
| Days between arthroscopic surgery and nonarthroplasty revision surgery   |                         |
| Average (SD)   | 591 (491)               |
| Range  | 105-1095                |
| Cases reported, No.  | 15                      |
| Average number of days between arthroscopic surgery and arthroplasty revision surgery (SD, range, number of cases in which the data were reported) | 930 (630, 270-2520, 29) |

SD, Standard deviation.

\* Data represent the number of shoulders with the finding.

† Gender was not identified for 23 patients in the literature review.

Unexpected postoperative pain, stiffness, and crepitation were the most common initial symptoms of chondrolysis. The average time between the index surgery and the first documentation of symptoms was 254 days (range, 42-730 days); however, that the actual onset of symptoms was likely to have been much sooner. The radiographic findings are summarized in Table II. Figs. 1 and 2 show the radiographic appearance of a shoulder before and after the onset of chondrolysis.

Thirty-seven shoulders underwent nonarthroplasty revision surgeries, such as capsular releases or débridement, and 54 underwent shoulder arthroplasty surgery (Table III). Typical findings at surgery for chondrolysis are shown in Figs. 3 and 4. Microbiologic cultures were taken during secondary surgeries in 41 cases with only 3 cases reporting growth, all with *Pseudomonas acnes*. No other mention of positive cultures was found.

## Discussion

### Factors reported in cases of chondrolysis

Our literature review on glenohumeral chondrolysis revealed that this condition has been observed in cases in which intra-articular dyes, thermal capsulorrhaphy, certain sutures and suture anchors, and the postarthroscopic intra-articular infusion of local anesthetics were used. Until the advent of arthroscopic surgery, glenohumeral chondrolysis was very rare. Only 4 cases had been reported, and all of these were related to the use of Gentian violet dye in the “color test” to identify and localize rotator cuff tears.<sup>36,37</sup>

Thermal capsulorrhaphy has been used in shoulder arthroscopic procedures for instability because of its ability to denature the triple helical collagen molecule.<sup>17,31,38</sup> Its use has been implicated in the pathogenesis of chondrolysis.<sup>6,14,18,25</sup> Multiple authors observed that thermal capsulorrhaphy and radiofrequency capsular release could be complicated by attenuation of the capsule, axillary nerve injury, and chondrolysis.<sup>1,8,22,32,33</sup>

**Table II** Summary of radiographic findings from the literature review

| Finding               | No. |
|-----------------------|-----|
| Joint space narrowing | 46  |
| Humeral cysts         | 24  |
| Glenoid cysts         | 25  |
| No osteophytes        | 19  |
| Minor osteophytes     | 3   |
| Major osteophytes     | 0   |
| Osteopenia            | 1   |
| Humeral bone loss     | 5   |
| Central glenoid wear  | 13  |
| Anterior glenoid wear | 0   |



**Figure 1** Anteroposterior radiograph of a left shoulder before arthroscopic surgery shows normal radiographic joint space and congruent joint surfaces.

Suture material and bioabsorbable anchors have been implicated in the development of synovitis and osteolysis of the shoulder secondary to foreign body reaction.<sup>2,4,7,10,11</sup>

Hansen et al<sup>16</sup> reviewed the records of 152 patients (177 shoulders) who underwent arthroscopic shoulder surgery, and chondrolysis developed in 12 (6.8%). Chondrolysis



**Figure 2** Anteroposterior radiograph of the same shoulder in Fig. 1 at 11 months after arthroscopic surgery and postoperative infusion of a solution of bupivacaine and lidocaine shows loss of radiographic joint space, joint incongruity, and cyst formation at the humeral articular surface.

**Table III** Summary of treatment of cartilage loss from the literature review

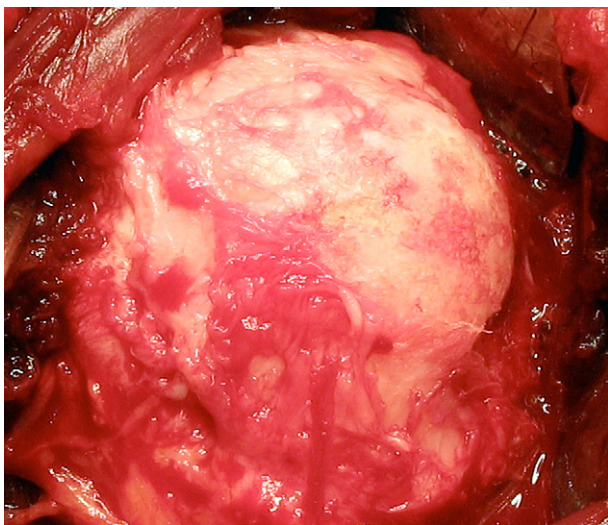
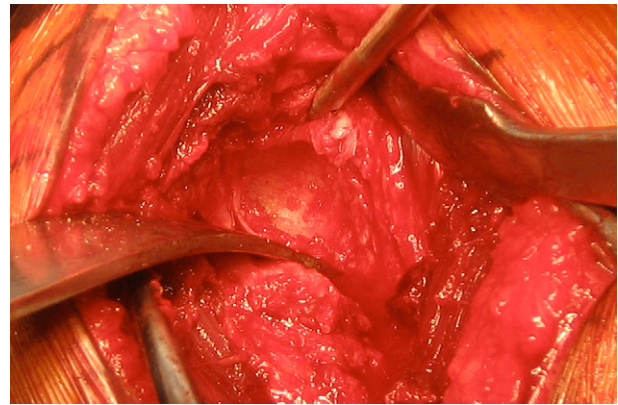
| Treatment                  | No. |
|----------------------------|-----|
| Hemi-arthroplasty          | 26  |
| Humeral resurfacing        | 7   |
| Meniscal allograft         | 14  |
| Other tissue interposition | 12  |
| Osteoarticular allograft   | 8   |
| Total shoulder             | 14  |

developed in 63% of 19 patients who underwent arthroscopic capsular stabilization with postoperative intra-articular pain pumps infusing bupivacaine and epinephrine.

Gomoll et al<sup>12</sup> investigated the effect of bupivacaine and bupivacaine plus epinephrine infusion on lapine articular cartilage.<sup>39</sup> Although they noted decreased sulfate uptake and cell viability in the treated joints, a follow-up study revealed no permanent impairment of chondrocyte function, cell viability, or histologic grade.<sup>13</sup>

The interpretation of the results of this systematic review are subject to several limitations. The number of shoulders from which these cases were drawn is unknown; as a result, the relative risk or hazard ratios for the use of intra-articular infusion of local analgesics or for the use of intra-articular radiofrequency cannot be determined. Although it is possible that these interventions have been used safely in many patients, it is also possible that many cases of chondrolysis after their use have gone unreported. Despite these limitations, several observations may be made regarding chondrolysis:

First, chondrolysis is a devastating complication of shoulder surgery in young active individuals undergoing relatively minor surgical procedures, including patients with no prior evidence of arthritis.

**Figure 3** Surgical photograph shows a right humeral head at the time of arthroplasty for severe chondrolysis.**Figure 4** Surgical photograph shows a right glenoid fossa at the time of arthroplasty for severe chondrolysis.

Second, chondrolysis is characteristically observed with arthroscopic rather than open surgery. Although it is not known whether shoulder arthroscopy increases the risk of chondrolysis, it is of note that in shoulder arthroscopy, the glenohumeral joint is perfused under pressure for an extended period with a solution that does not have the same temperature, oxygenation, pH, viscosity, and nutrient composition as normal joint fluid. The infusion pressure in arthroscopy may exceed that demonstrated to cause tissue ischemia in compartmental syndromes.<sup>27,28</sup>

Third, chondrolysis can be observed with the postoperative infusion of a solution that does not have the same temperature, oxygenation, pH, viscosity, and nutrient composition as normal joint fluid.

Fourth, chondrolysis observed with the postsurgical infusion of local anesthetics occurs with various local anesthetics, with or without the inclusion of epinephrine.

Fifth, although the definitive diagnosis of chondrolysis is typically delayed, the case histories strongly suggest that the postoperative course is one of unexpected and often progressive pain and stiffness that can develop in the early postoperative course but may also be delayed for some time.

Sixth, the radiographic and pathologic findings of chondrolysis are remarkably consistent, consisting of the total loss of the articular cartilage on both the glenoid and the humeral joint surfaces. This pattern is not one that would be expected from a mechanical cause, but rather one that would be expected from a global hypoxic, malnutritional, autoimmune, or toxic etiology.<sup>5,9,12,13,20</sup>

## Conclusion

A review of the available literature indicates that chondrolysis can be observed after arthroscopic surgery in individuals of either gender undergoing surgery for instability, superior labrum anteroposterior lesions, and rotator cuff disorders. Chondrolysis can occur in patients in a broad age range and with many routine arthroscopic procedures. Most of the reported cases have been

associated with the postarthroscopic infusion of local anesthetic (bupivacaine or lidocaine, with and without epinephrine). The second most common association has been with the use of intra-articular radiofrequency energy for capsulorrhaphy. Surgeons should consider avoiding the use of these interventions unless they are essential to the treatment of the shoulder pathology.

## Disclaimer

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