"Typical" Rotator Cuff Impingement Syndrome: It's Not Always Typical

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Objectives

After reading this article, you should be able to:

- Describe tests and measures that can be used in the examination of patients with shoulder pain.
- Describe how the physical therapist's evaluation of GK's examination results led to the diagnosis.
- Describe the rationale--based on the available literature and clinical experience--used by the physical therapist to design a rehabilitation program for GK.
- List the red flags that the physical therapist detected on examination.

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Introduction

During the past 20 years, there has been a surge of interest in and knowledge about the shoulder. The shoulder is now recognized as one of the principal sites of sports injuries, work-related injuries, arthritis, and age-related degeneration.[1] We are in an age of discovery regarding the mechanisms of shoulder stability, rotator cuff degeneration, and the basic mechanics of the shoulder itself.

Rotator cuff impingement syndrome is reportedly one of the most common causes of shoulder pain and dysfunction, both in the general population[2,3] and among athletes.[4-6] Despite the common occurrence of disorders related to rotator cuff impingement syndrome—and despite the orthopedic surgeon's and the physical therapist's longstanding interest in the rotator cuff—controversy and misconceptions remain regarding treatment of rotator cuff disorders.[7] Although numerous studies have been published on the use of various nonoperative interventions for these disorders, there is limited evidence to indicate what techniques work best for different types of patients.

Knowledge of the pathogenesis, natural history, and diagnosis of shoulder impingement syndromes and an understanding of the various treatments described in the literature are crucial to the management of shoulder dysfunction. Equally important: the recognition of atypical responses to intervention programs designed for patients with shoulder pain. In the following case example, a patient has been referred to an outpatient physical therapy clinic by an orthopedic surgeon who has made a diagnosis of "rotator cuff strain from overuse."

Examination

History

GK is a 24-year-old man who has been employed as a truck driver for about 4 years. He participates in recreational softball leagues several nights per week in the summer and plays golf one or two times per week during the spring, summer, and fall seasons.

During the physical therapist interview, GK explains that pain in his right (dominant) shoulder began 5 months ago when he was loading and unloading considerably more truck cargo than he normally handles. He does not recall one specific incident when he might have strained or injured his shoulder. He reports that his shoulder pain is aggravated by loading and unloading his semi-trailer and by driving more than 6 hours per day, especially when he repeatedly turns the steering wheel sharply.

GK states that when he has to do a great deal of lifting, his shoulder becomes "tired and sore." He also says that his shoulder occasionally "catches and locks." Through further questioning, the therapist determines that GK's shoulder has never actually locked and that GK is able to move his shoulder during these "pseudo-locking" episodes. The pain sometimes awakens GK at night, particularly if he has driven a great deal during the day and then played a sport in the evening.

GK recalls that he injured the same shoulder several years ago while playing high school football. He does not remember the details of the injury but says that his orthopedic surgeon at the time "called it a subluxation." Since that injury, GK says, he had no problems with his shoulder until 5 months ago. At that time, his primary care physician referred him to a physical therapist, who decided to implement a conservative course of intervention that consisted of ultrasound, hot packs, and a

minimal protocol of exercises (eg, shoulder internal and external rotation exercises using surgical tubing). After a month of this conservative approach, GK continued to have stiffness and pain in his shoulder, particularly after unloading his truck. He returned to his primary care physician, who administered a cortisone injection that diminished GK's pain.

When the pain returned 2 or 3 days after the injection, the physician referred GK to an orthopedic surgeon, who ordered shoulder radiographs with the shoulder in external rotation (**Fig 1**). The radiographs indicated that there were no fractures or other abnormalities. Based on GK's ongoing impingement symptoms and his lack of response to a conservative course of physical therapy, the orthopedic surgeon recommended a diagnostic arthroscopy and subacromial decompression to eliminate compression (impingement) of the subacromial contents.[8-10] Reluctant to undergo an invasive procedure, GK requested a second opinion.

A second orthopedic surgeon examined GK, reviewed the radiographs, and discussed GK's previous course of physical therapy. The surgeon confirmed that the radiographic findings were unremarkable. He noted that GK has a type I (or flat) acromion morphology, which, as reported by Bigliani et al,[11] is less likely than a type II or III acromion to be associated with rotator cuff impingement syndromes. The surgeon made a diagnosis of "rotator cuff strain from overuse" and referred GK to a physical therapist for a more aggressive intervention program.

Systems Review

The physical therapist determines that there are no neuromuscular, cardiopulmonary, or integumentary problems and that, with the exception of his shoulder pain, GK is healthy. GK states that he has had no injuries to and no problems with the left shoulder or left arm; cervical or thoracic spine; or right elbow, forearm, wrist, or hand. He has no limitations with communication. GK reports that he has no history of hospitalizations or surgical procedures. There is no history of shoulder problems in the immediate family.

Tests and Measures

Anthropometric characteristics. GK has a height of 6 feet and a weight of 220 pounds. He has an endomorphic body type.

Pain. GK indicates (by pointing with his index finger) that his pain is located on the superior lateral aspect of the right shoulder. Using a visual analog scale (VAS) (0=no pain, 10=worst pain), the physical therapist records GK's pain level as 1/10 at rest, 2/10 during activities of daily living (ADL) performed below shoulder height, and 7/10 during overhead ADL and sports activities (eg, throwing). GK reports his pain level as 2/10 with palpation of the acromioclavicular joint, 4/10 with palpation of the supraspinatus tendon insertion, 2/10 with palpation of the coraco-acromial ligament, and 1/10 with palpation over the anterior glenohumeral joint capsule.

Joint integrity and mobility. In order to determine whether instability or impingement—or both—are contributing to GK's shoulder pain, the physical therapist believes it is necessary to perform specific "special tests" of different structures to implicate or rule out shoulder instability or impingement syndromes.[12] GK has positive results on the anterior load and shift test (for instability),[13] the Neer impingement test,[10] the Hawkins-Kennedy impingement test,[4,14] the coracoid impingement test,[7] the crossover impingement test,[15] and the Jobe subluxation/relocation (anterior) test (for instability).[16] Test results were negative for the uninvolved shoulder.

Posture. Using a posture grid and the criteria proposed by Kendall et al,[17] the physical therapist observes that GK has a "normal" frontal- and sagittal-plane standing posture. His right shoulder is 1 centimeter inferior relative to the left shoulder when his arms are in a neutral (abduction=0°) position. GK sits in a "slouched" (kyphotic) posture. His thoracic flexion is increased by 1 centimeter (as measured using tape from the L5 to C7 spinous processes) in the sitting position compared with the standing position. Using the lateral scapular slide test,[18,19] which is performed by measuring the distance between the T7 spinous process and the inferior angle of the scapula, the physical therapist finds that both scapular inferior angles are abducted 2 centimeters farther from the T7 spinous process in the sitting position compared with the standing position.

Sensory integrity (including proprioception and kinesthesia). The physical therapist finds that sensation to light touch is intact and consistent along the upper-extremity dermatomes.

To assess GK's joint position sense, the physical therapist performs kinesthetic testing.[18,20-26] He uses an electronic inclinometer[18] to measure GK's ability to replicate joint angles during shoulder flexion, abduction, and internal and external rotation. During abduction with GK seated, the therapist notes a difference of 10 degrees in the involved shoulder between the angle that is actually achieved (125°) and the attempted replication angle (135°). During internal and external rotation to 45 degrees (in the supine position with the arm abducted to 90°), the therapist notes differences of 7 degrees and 10 degrees, respectively, between the angles that are achieved and the attempted replication angles in the involved shoulder. For all angles tested, GK is able to replicate angles within 5 degrees using his uninvolved shoulder.

Reflex integrity. Biceps, brachioradialis, and triceps deep tendon reflexes are normal.

Range of motion (ROM) (including muscle length). The physical therapist measures flexion and abduction with the arm in the glenohumeral neutral position and the scapulothoracic neutral position. In the involved shoulder, the physical therapist finds that flexion is 0 to 140 degrees (normal=0°-180°) and abduction is 0 to 120 degrees (normal=0°-180°). With the shoulder in 90 degrees of abduction, composite internal rotation (glenohumeral internal rotation and scapulothoracic protraction) is 0 to 50 degrees (normal=0°-70°), and external rotation is 0 to 60 degrees (normal=0°-90°). GK demonstrates a painful arc syndrome27 (80°-120°) with flexion and abduction. He has unrestricted active ROM in the uninvolved shoulder. Considering that scapular asymmetry may correlate with impingement,[19] the physical therapist uses the modified lateral scapular slide test to compare scapular movement between sides during abduction.[18,19] The test is performed by measuring the distance between the T7 spinous process and the inferior angle of the scapula when the arm is in five different positions: neutral (abduction=0°), abducted approximately 45 degrees (hands placed on iliac crests), abducted 90 degrees with full internal rotation, abducted 120 degrees, and abducted 150 degrees. According to Kibler,[19] a difference of greater than 1 centimeter between sides when the arm is in the approximately 45-degree position or in the 90-degree position correlates with glenohumeral impingement. In GK's case, more than 1 centimeter is measured on the right at the 90-, 120-, and 150-degree abduction positions.
Examination of the glenohumeral joint reveals hypomobility (with a capsular end-feel) of caudal glide and posterior glide when compared with the unaffected shoulder. Anterior glide is greater on the involved side than on the uninvolved side.

Muscle performance (including strength, power, and endurance). Using various positions for manual muscle testing as described by Jobe et al,[28] Kelly et al,[29] and Sapego and Kelly[30] and the five-point scale described by Kendall et al,31 the physical therapist measures 5/5 ("normal") muscle strength throughout the left shoulder. Weakness (4/5) is present in the right shoulder during flexion, abduction, scaption (elevation in the scapular plane), and external rotation (with VAS pain scores ranging from 1/10 to 3/10).
The legs and torso (core) may contribute to the development of forces at the shoulder.[19,32] The torso functions as a transfer link between forces generated in the legs and shoulders.[32] The physical therapist therefore decides to assess torso and leg strength to determine whether weaknesses in these muscle groups may be contributing to GK's shoulder dysfunction. Manual muscle testing reveals 4/5 weakness in all of the trunk flexors. Manual muscle testing of the lower extremities shows 4/5 weakness bilaterally in the hip extensors and hip abductors.

Because of GK's pain during manual muscle testing, the physical therapist decides to postpone isokinetic testing[30,33-39] and the functional throwing performance test,[18] planning instead to perform these tests during a future reexamination when GK no longer has pain with manual muscle testing or functional shoulder movements.

Ergonomics and body mechanics. To simulate the loading and unloading of cargo to and from his semi-trailer, GK is asked to transfer several weighted boxes to and from a plinth and a makeshift pallet that is located on the gym floor 30 feet away from the plinth. He flexes his hips and knees when lowering to pick up boxes from the floor and extends his hips and knees to return to the upright position. While transferring, he maintains the boxes tight against his abdomen. Throughout the simulated work task, GK maintains a neutral (mid-ROM) lumbar posture. Shoulder positioning is symmetrical during lifting; however, he reports pain of 2/10 with repetitive lifting.

Evaluation

Diagnosis

Considering the examination findings and using the framework provided by the ***Guide to Physical Therapist Practice*** (Guide),[40] the physical therapist makes a diagnosis of Musculoskeletal Pattern 4F, "Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Localized Inflammation."

Several of the examination findings show a cluster of signs and symptoms that suggest to the physical therapist that GK has a secondary subacromial impingement syndrome. Positive results on only the impingement tests might have suggested a primary impingement; however, the positive results on the anterior load and shift test and the Jobe subluxation/relocation (anterior) test indicate laxity of the anterior glenohumeral capsulo-ligamentous restraints, which leads the physical therapist to suspect a secondary subacromial impingement.

Harryman et al[41] suggested that hypomobility of the posterior glenohumeral joint capsule may contribute to subtle anterior capsular laxity. The therapist believes that GK's subtle anterior laxity, which may have resulted from a high school football injury and other previous activities, is likely contributing to GK's impingement symptoms. The therapist hypothesizes that the weakness detected with manual muscle testing during shoulder elevation and external rotation may be contributing to an imbalance of the rotator cuff and deltoid force couple and subsequent subacromial impingement.[42] Additional related signs and symptoms include decreased ROM during active elevation and rotation and a painful arc syndrome during elevation. The 7- to 10-degree difference in joint angle replication between shoulders suggests that GK has impaired joint mobility and impaired sensory integrity (kinesthesia and proprioception) in his involved shoulder.[18]

GK has reported that his symptoms began during a period of time when he was doing more loading and unloading than usual; based on this information, the physical therapist suspects that GK has a secondary (hypermobile) rotator cuff impingement syndrome as a result of underlying micro-instability related to microtraumatic overuse, with chronic rotator cuff tendinitis and subacromial bursitis.[11,43,44]

Prognosis

According to the Guide, the expected range of number of visits for an episode of care for 80% of patients with this diagnosis is 6 to 24; a return to premorbid or highest level of function is expected within 8 to 16 weeks. Factors that may modify the range of number of visits for patients with this diagnosis include age, chronicity or severity of the condition, comorbidities, ongoing aggravating risk factors (eg, repetitive motion), and level of participation in the intervention program. In the case of GK, the physical therapist anticipates that ongoing repetitive motion would be the only factor that might necessitate an increase in the frequency of visits or the duration of the episode of care. The physical therapist recalls that, according to the radiographs, GK has a type I acromion morphology. In a study involving more than 600 patients, Morrison et al[45] reported that, among those with a subacromial impingement who had a type I acromion, "nonoperative management" had a success rate of 91%, with many patients obtaining symptom relief within 4 to 6 weeks. The therapist decides to design a nonoperative intervention program, with the anticipation that GK will achieve symptom relief within the 4- to 6-week time frame described by Morrison et al and therefore will be among the 20% of patients whose number of visits falls outside the expected range.

The physical therapist plans to treat GK two or three times per week for approximately 1 month. In the therapist's region, the managed care network requires the patient to be reexamined at 4 weeks by both the physical therapist and the referring physician, who jointly assess progress and status and determine further intervention.

Plan of care. Anticipated goals, determined by the physical therapist in consultation with GK, include the following:

- Reducing pain (from 7/10 to 2/10 during overhead ADL and sports activities).
- Reducing joint and soft tissue swelling, inflammation, and restriction.
- Improving joint integrity and mobility and restoring full active ROM within 2 weeks so that GK can perform overhead ADL with less pain.
- Increasing muscle performance (including restoration of "normal" strength as measured with isokinetic testing using bilateral comparison) within 4 weeks so that GK can lift at work and perform overhead recreational activities without limitations.
- Reducing the risk of recurrence.

Expected outcomes include a return to all job-related and recreational activities and a reduction in the risk of disability.

Intervention

To help manage GK's pain, the orthopedic surgeon prescribes a nonsteroidal anti-inflammatory drug. The physical therapist's interventions will consist of therapeutic exercise and various physical agents—such as phonophoresis with hydrocortisone applied over the symptomatic rotator cuff tendons and cryotherapy with electrotherapeutic modalities (ie, microelectroneural stimulation and interferential current)—to help decrease pain and inflammation.[7,46] The therapist plans to provide patient-related instruction throughout intervention.

Therapeutic Exercise

Posture awareness training. Observation of GK's posture during the examination revealed his tendency to "slouch" while sitting. Understanding that the combination of scapular abduction (protraction) and thoracic flexion during a slouched posture reduces the subacromial volume and may induce soft tissue impingement,[47] the therapist wants GK to "internalize" a more extended thoracic and adducted scapular posture to improve his overall posture. To accomplish this, the therapist provides exercise instruction to GK in front of a full-length mirror for maximal visual feedback. During instruction, the therapist explains the implications of thoracic and scapular posture on glenohumeral function.

Strengthening. Because numerous investigators have found that weakness of the shoulder musculature correlates with shoulder impairments,[35,36,48-56] the physical therapist selects several therapeutic exercises to strengthen GK's shoulder musculature.[57,58]

Prior to each strengthening exercise session, GK performs upper-body ergometer cycling both to warm up and to help improve the strength and endurance of the trunk, scapular, shoulder, and arm muscles. Because the therapist wants to strengthen the shoulder external rotators and scapular retractors, he emphasizes retro-cycling.
The therapist instructs GK to perform strengthening exercises in a "superset" fashion; that is, exercising the agonist and antagonist muscles in a reciprocal manner. The rationale: to maintain muscle balance in the shoulder complex by working opposing muscles. The therapist believes that this approach is efficient because as the agonist is being exercised, the antagonist experiences

relative rest, and vice versa; therefore, there is no need to wait for muscle recovery between sets. As described in classic literature on progressive resistive exercise,[59] the therapist asks GK to perform 3 sets of 10 repetitions at a level of resistance that is comfortable for him (ie, causing minimal pain).

The physical therapist's intent is to provide gradually increasing stresses to the contractile tissues so that regeneration and remodeling processes are not disrupted.33 Because the therapist's hypothesis is that GK's shoulder dysfunction is the result of overuse, he believes it is important to allow the injured tissues to heal. Exercise progression for GK includes multiple-angle isometric, short-arc, and full range-of-motion exercises. Because several studies have shown that strengthening is beneficial in alleviating subacromial impingement symptoms,[35,42,60-68] the physical therapist decides to focus on strengthening the scapulothoracic muscles and the rotator cuff to improve functional stabilization and dynamic caudal glide of the glenohumeral joint. He includes four core exercises recommended by Townsend et al[58] to strengthen the glenohumeral musculature. Townsend et al found that four exercises—press-up, flexion, horizontal abduction with humeral external rotation, and scaption (elevation in the scapular plane)—challenged all of the glenohumeral muscles. The physical therapist decides to modify the scaption exercise described by Townsend et al in such a way that the humerus is externally rotated to avoid subacromial compression. His rationale is based both on his clinical experience and on his reading of the literature: (1) He has found that performing the exercise with the humerus internally rotated often results in iatrogenic pain, and (2) Itoi et al[69] reported that the "full can" position (humeral external rotation) is as effective in isolating the supraspinatus as the "empty can" position (humeral internal rotation) and is more comfortable for patients.
Because GK has anterior laxity, the therapist focuses on developing posterior shoulder strength.[18,33,70] He applies the "contre-coup" concept of shoulder stability, which emphasizes developing strength on the side that is opposite to the laxity to provide dynamic compensation for the underlying static restraint incompetency.[33,70,71] For many patients with shoulder dysfunction and especially those with anterior instability, strengthening of the infraspinatus and teres minor muscles may increase the unilateral ratio of external to internal rotators by an additional 10%, creating a "posterior dominant shoulder."[33,70] In GK's case, the therapist hopes to increase the unilateral ratio from about 66% to about 76%. Isokinetic devices can be used both to test and to strengthen the glenohumeral rotator musculature.[33,72-75] Hawkins and Kennedy[4] found that positions that elicit impingement symptoms (eg, 90° abduction) should be avoided when attempting to strengthen the humeral rotators at the beginning of a rehabilitation program; therefore, the therapist decides to instruct GK to perform isokinetic humeral rotator exercises with his shoulder in a modified neutral (30° scaption) position[33,56] to begin the strengthening program. When his symptoms allow, GK will be instructed to perform this exercise with his arm in 90 degrees of abduction to prepare him for softball throwing.

As noted, the physical therapist has hypothesized that GK's impingement is related to his anterior capsular laxity. The therapist refers to studies by Allegrucci et al[43] and Brewster et al[76] that demonstrate the importance of avoiding stress on the anterior capsular restraints while exercising the glenohumeral musculature. Based on these studies, the therapist decides that most of GK's exercises should be performed in the scaption position (30° anterior to the frontal plane). Using this rationale, the therapist determines that the following exercises are contraindicated for GK because of their potential to stress the anterior glenohumeral capsular restraints: behind-the-neck latissimus dorsi pull-downs, behind-the-neck military presses, and wide-grip bench presses.[6]
The physical therapist also instructs GK in scapulothoracic exercises.[18,19,57,77] Based on Kibler's discussion of the role of the scapula in overhead throwing,[19] the asymmetrical scapular position that the therapist measured during the modified lateral scapular slide test suggests that the scapulothoracic articulation may be contributing to GK's glenohumeral dysfunction. Because the scapula provides a dynamic base of support for efficient use of the arm,[19,77] the therapist incorporates resistive exercises for the scapulothoracic musculature as advocated by Moseley et al.[57] Moseley et al found that four exercises target the muscles responsible for scapular control: push-up with a plus (or chest press with a plus), rowing, press-up, and scapular plane elevation (scaption) with humeral external rotation ("full-can" position).

To strengthen the entire upper-extremity kinetic chain, the physical therapist incorporates elbow and wrist flexor and extensor strengthening exercises.[78,79]

Activities such as loading and unloading a truck during the day and then playing softball in the evening require adequate total-body strength.[18,19] The therapist therefore wants to address lower-extremity weakness and includes the leg press, leg (hamstring) curl, and resisted hip abduction. To address weakness in the trunk flexors, GK is instructed in trunk flexion and rotation exercises on selected weight stack machines. In addition, GK uses a Versa-Climber®* to simultaneously exercise the upper extremities, trunk, lower extremities, and the cardiovascular system.

Kinesthetic/proprioception exercises. Several studies have indicated that patients with shoulder instabilities have kinesthetic deficits.[18,20,22-26,80] Furthermore, Lephart et al[24] demonstrated that with surgery and rehabilitation, these deficits can be reduced. There is still a great deal of

uncertainty, however, about the best method of improving kinesthesia in the shoulder.[18,26,81] Although the therapist recognizes that there is limited evidence to indicate the most effective way to approach kinesthetic deficits, he believes that these deficits are contributing to GK's problem and therefore must be addressed.
Based on clinical experience, the therapist decides to use manual rhythmic stabilization (perturbation) exercises (eg, place the patient in different positions and apply resistance, using submaximal to maximal intensity, varying velocities, and both known and unknown movement patterns), closed kinetic chain exercises for the shoulder (eg, tiltboard training), and plyometric training to help improve kinesthetic awareness.[18,25,26,66,68,82] Plyometric training has been advocated as a means of enhancing shoulder-complex performance[18,73,82,83]; however, the therapist finds that few studies have been published on this topic, and most of the available information is anecdotal. Because plyometric exercises require the ability to produce forceful eccentric and concentric contractions, the therapist decides that he will incorporate them into the intervention program only when GK shows normal (5/5) strength with manual muscle testing.

Manual Therapy (Including Mobilization

In addressing GK's joint arthrokinematics, the physical therapist uses mobilization techniques, thermal modalities with stretching, and self-stretching exercises that can be used to create a plastic deformation for the areas of the capsule (noncontractile tissues) that are hypomobile.[84] These treatment techniques are focused on the selective hypomobility of the posterior capsule. Static stretching and proprioceptive neuromuscular facilitation (PNF) contract-relax exercises can be used to help increase the flexibility of the posterior (infraspinatus, teres minor) contractile muscle-tendon unit.[5,84]

The physical therapist follows the application of mobilization techniques with strengthening exercises and expects that as GK gains passive motion, he may also gain stability in the newly gained ROM, thus improving overall function.

Reexamination: "Red Flags"

At the 1-month reexamination, GK reports somewhat less pain using the VAS (5/10 during overhead ADL; 2/10 with palpation of the supraspinatus tendon insertion; and no change with palpation of the acromioclavicular joint, the coraco-acromial ligament, and anterior glenohumeral joint capsule). He also shows some improvement in active ROM (flexion increased by 10°; abduction, by 20°; and internal and external rotation, by 15°). His strength remains 4/5 on manual muscle testing, and the anticipated goal of reducing pain with overhead ADL from 7/10 to 2/10 has not been met. The physical therapist believes that these results are not typical for a patient with a suspected secondary rotator cuff impingement syndrome. He detects two "red flags" in this case:

- GK is a young, healthy patient with no major history of trauma who has continued complaints of "catching" and "locking" ("Sometimes I feel like I can't move my shoulder"). These complaints of pseudo-locking are not typical of patients with rotator cuff impingement syndromes due to microtraumatic overuse.[1,6,16]
- GK is a young, healthy patient with no major history of trauma who, in the clinical experience of the physical therapist, is responding very slowly to the intervention program. The therapist has found that most of his patients with a secondary impingement syndrome improve at a faster rate.

Because of these concerns, the therapist refers GK to the orthopedic surgeon for further evaluation. Although the patient's first set of radiographs (**Fig 1**) were unremarkable and there have been no traumatic injuries since his original sports injury several years ago, the surgeon decides to obtain another radiographic series of the shoulder (**Fig 2**). A set of anteroposterior radiographs is taken in the plane of the scapula with the arm in 20 degrees of external rotation. These radiographs show multiple circular or oval calcifications with well-defined borders within the glenohumeral joint capsule. The calcifications have a clustered, "honeycomb" appearance. Axillary and lateral scapular views confirm that the masses are confined to the glenohumeral joint. The surgeon orders magnetic resonance imaging, and the results confirm the radiographic findings.

Based on these findings, the orthopedic surgeon recommends a diagnostic arthroscopy. The arthroscopic examination reveals multiple partially calcified white, shiny chondral loose bodies associated with synovial osteochondromatosis (**Fig 3** and **Fig 4**) within the glenohumeral joint. The surgeon performs a synovectomy (**Fig 5**) and removes approximately 10 shiny, cartilaginous masses that are 3 to 10 millimeters in diameter (**Fig 6**). Based on the patient's complaints, the surgeon believes it is likely that the loose bodies were present when earlier radiographs were taken but had not yet calcified sufficiently to be detected on radiographic film. Synovial osteochondromatosis may cause subacromial impingement and pseudo-locking when cartilaginous masses infiltrate the subacromial bursa.[85-88]

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Figure 1.

Figure 2.

Figure 3.

Figure 4.

Figure 5.

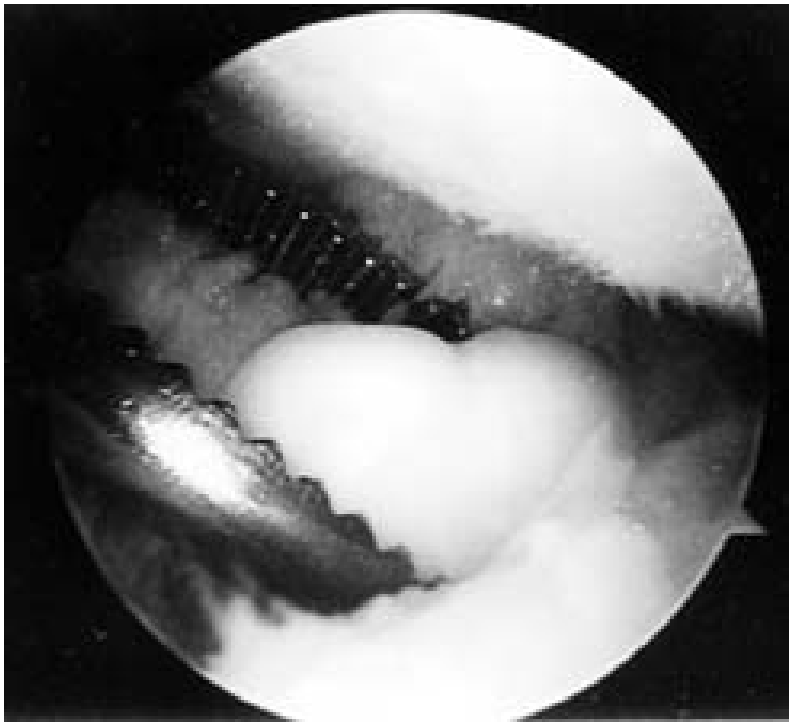

Figure 6.