Scapular-Dysfunctional Impingement Syndrome as a Cause of Grade 2 Rotator Cuff Tear: A Case Study

Dale J. Buchberger, D.C., C.C.S.P.[1]

Abstract: ***A case of scapular dysfunctional impingement syndrome (SDIS) with an associated grade 2 rotator cuff tear is reported in a 17-year-old male high school baseball pitcher. He had experienced an acute onset of left anterolateral shoulder pain immediately after "one particular pitch." A comprehensive nonsurgical treatment plan was used and included myofascial release technique, low voltage-ultrasound combination, contract relax technique, chiropractic manipulative therapy, and active exercise rehabilitation. He fully recovered to pitch at the college level and expressed an increase in velocity and control. It must be recommended that preseason examination in baseball players include aggressive manual examination (by a skilled examiner) of the subscapular/scapulothoracic region to diagnose latent SDIS. Baseball players, especially pitchers and catchers, if diagnosed with either latent or active SDIS should under go immediate treatment and exercise rehabilitation as outlined.***

Key Words: baseball, impingement syndrome, shoulder, manipulation, rotator cuff, scapula.

To understand the concept of scapular dysfunctional impingement syndrome (SDIS) in the throwing athlete (Fig. 1), the clinician must have a thorough working knowledge of throwing mechanics (1) as they relate to scapulothoracic motion (2) and of the consequences of microtrauma to the soft tissue structures between the anterior surface of the scapula and the rib cage (1–5). In addition, the importance of scapulothoracic motion to proper glenohumeral biomechanics must be appreciated (1,3,6). The repetitive scapulothoracic microtrauma involved in high-velocity pitching ultimately leads to the formation of reactive fibrous adhesions between the subscapularis and the serratus anterior. (For the purpose of this article, future reference to reactive fibrous adhesions between the subscapularis and serratus anterior will be referred to as scapulothoracic adhesions [2,7–10].) Hammer states, "it is essential to consider the relationship between the scapula and the glenohumeral joint in all shoulder problems" (6). Dysfunctional scapular motion will put the supraspinatus, infraspinatus, teres minor and subscapularis (SITS) muscles at a mechanical disadvantage (6).

The scapula must function flawlessly and stabilize securely, creating an unyielding base against which the humeral head can act (6). During throwing, alteration in scapular motion will, according to Ryu and colleagues (11), "endanger scapulothoracic-glenohumeral synchrony and lead to abnormal compensatory biomechanics."

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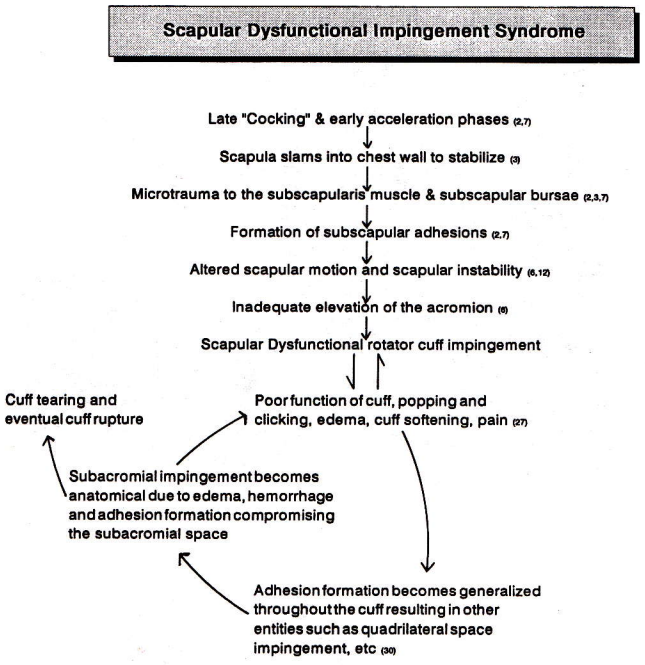

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Figure 1. Flow chart depicting the development of SDIS and associated progressive sequelae.

It is the fibrous adhesion formation that results in altered scapular dynamics (7), insufficient acromial lift (6), deficient force couple (8), and impingement of the supraspinatus tendon against the under side of the acromion (5). Scapulothoracic adhesion first creates an anatomical block of acromial lift by preventing the scapula from freely rotating about the thorax. The limited scapular rotation results in weakness and atrophy of the subscapularis and serratus anterior, causing further reduction in the acromial lift and force couple mechanism.

Appropriate manual examination in the preseason can lead to an early diagnosis of SDIS while it is still in the asymptomatic (latent) stage. Diagnosis in the latent stage allows for early treatment and rehabilitation without a loss of playing time. Manual examination is crucial in the diagnosis of SDIS because the entity is not visualized on traditional diagnostic imaging studies, such as magnetic resonance imaging, computed tomography, arthrography, and plain film radiographs. Therefore, appropriate manual treatment is often overlooked and traditional methods of rehabilitation and treatment are used in its place with unfavorable results.

This report will present a case of SDIS in an athlete with an associated grade 2 rotator cuff tear (5), resulting from scapulothroacic fibrous adhesion formation (2,7–10). This author believes this to be a common cause of supraspinatus impingement in baseball players, especially pitchers and catchers.

CASE HISTORY

A 17-year-old male high school baseball pitcher came to our office complaining of left anterolateral shoulder pain of approximately 1 month's duration. He experienced an immediate onset of pain after "one particular pitch," (a three-fourths delivery fastball). He called the coach and "took myself out of the game."

The high school athletic trainer treated him with rest, ice, and over-the-counter anti-inflammatory medication. As this treatment routine was ineffective, and he was then referred to our office.

His shoulder is painfree during warm-up, but fatigue and pain set in approximately two to three innings into the game. The coaches notice his elbow "dropping" at this time. Pain reduces with rest and ice. Occasionally, he has difficulty sleeping because of the pain and there is an increase in pain and stiffness in the morning. He currently is able to throw but has noticed a great decrease in velocity and control (5). He throws with a 3/4 arm delivery with moderate leg lift. His complement of pitches include a fastball, circle (o.k.) change, curve, and slider.

A current past medical history includes an episode of acute left medial epicondylitis in the summer of 1991. He was treated with rest, ice, physical therapy, and exercise rehabilitation. Recovery was without incident. It was also revealed that he had neglected to do his normal off-season weight training the previous winter.

PHYSICAL EXAMINATION

Physical examination revealed a 17-year-old male high school baseball pitcher who is left handed. Active range of motion of the left shoulder girdle appeared within normal limits, with pain being produced at 90° of abduction and continuing up to 180° of abduction/external rotation. Passive range of motion (PROM) is also within normal limits and produces a similar pain pattern. This is suggestive of a partial supraspinatus tear (grade 2) (5) and impingement (5,6).

Manual muscle testing (MMT) of the rotator cuff muscles revealed the infraspinatus and terès minor to be 4/5 (a standard neurological grading scale of 5/5 was used) without pain, the subscapularis to be 4/5 and painful, and the supraspinatus, tested in the "empty the can" position (thumbs down) (5,12) to be 4/5 with severe pain. All other major upper extremity muscle groups were 5/5 without pain.

Neurological examination was nonrevealing. Palpation of the SITS muscles revealed multiple areas of painful chronic fibrous adhesion (8–10). Palpation of the subscapularis adhesions reproduced the patient's pain and symptoms specifically to the area of complaint. Further palpation of the scapulothoracic region revealed scapulothoracic adhesion limiting free scapular function, specifically scapular rotation (6). The interscapular spinous processes from T2 through T7 were extremely tender to palpation. Motion palpation in this area displayed intervertebral and costovertebral joint dysfunction (13). The glenohumeral joint was intact and statically stable. Apprehension test (14) and clunk test (5) were both negative. The bicipital tendon and transverse humeral ligament were stable and painfree. The acromioclavicular

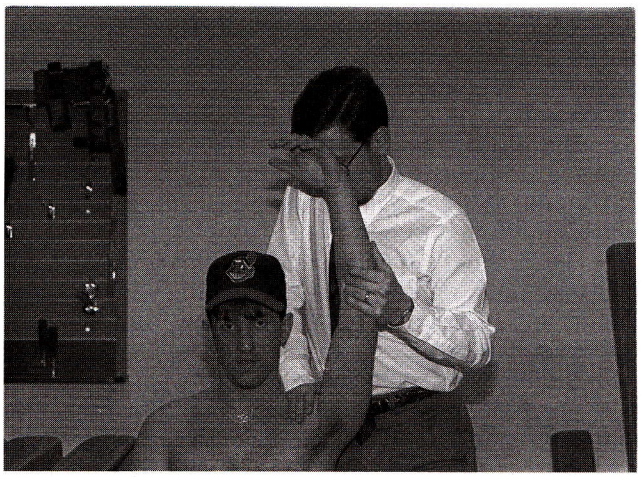


Figure 2. Impingement sign—forced forward flexion with stabilization of the acromion (patient passive).

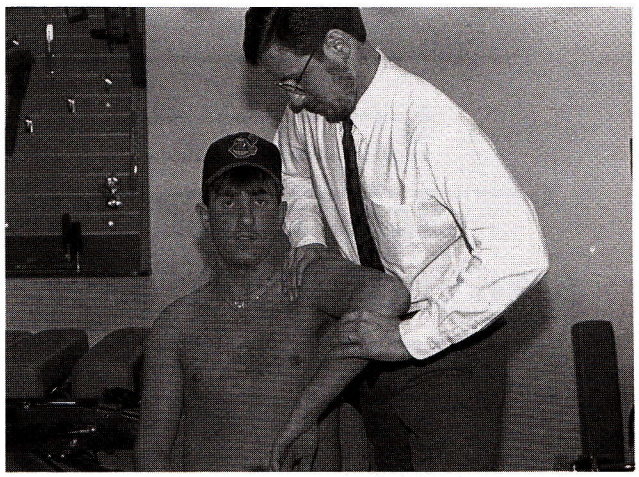


Figure 3. Hawkins sign—forward flexion with forced internal rotation (patient passive).

and sternoclavicular joints were intact, with the acromioclavicular joint exhibiting dysfunction (13) (fixation) on PROM of the glenohumeral joint (6).

The supraspinatus press (15) was painful. Impingement sign (4,12) (Fig. 2), forced forward flexion with downward pressure on the acromion (preventing scapular rotation), and Hawkins sign (12) (Fig. 3), placing the shoulder in a position of forward flexion and forced internal rotation, were both positive, indicating subacromial impingement (5,12).

IMPRESSION

Correlation of the history, symptoms, and physical examination findings reveal active SDIS (Table 1) with an associated grade 2 (5) rotator cuff (supraspinatus) tear. Chronic scapulothoracic and subscapularis adhesion formation have led to reduced scapular rotation, inadequate acromial lift (6), and deficient force couple (8), reducing relative area in the subacromial space. This has produced impingement and wear, resulting in a grade 2 (5) rotator cuff tear.

MANAGEMENT

A myofascial release technique (8–10) was used to reduce intermuscular and intramuscular fibrous adhesion in the rotator cuff musculature, with special attention to the scapulothoracic region. This will assist in restoring normal muscular function, restoring synergism to the rotator cuff, reestablishing the force couple mechanism (5,6,8,10,16), and allowing full scapular rotation to occur. Reducing scapulothoracic adhesion allows for proper rotation of the scapula and resultant acromial lift (2,5). This produces an increase in the relative area in the subacromial space and reduces impingement of the subacromial contents.

This was followed with the application of low-voltage ultrasound in combination at 1.5 W/cm^2 pulsed for 8 minutes (after the first week of treatment the ultrasound was changed to continuous mode) (17). Contract-relax (18) technique was then performed to increase flexibility and range of motion at the glenohumeral joint (1). In addition to improving function, the previously mentioned techniques are also thought to assist in improving the alignment of collagen fibers, minimizing the amount of and increasing the strength and flexibility of the scar formation during the healing process (1,16,17).

Chiropractic manipulation (19) was used for the interscapular, cervical, costovertebral, and acromioclavicular articulations to restore joint play (13) and protect function of the kinetic linkage mechanism (1,5,20).

Table 1
Criteria to delineate active from latent SDIS

Active SDIS
Anterior or anterolateral shoulder pain
+ Reduced performance
+ Impingement sign
+ Hawkins sign
− Yergasons test
pain on forced forward flexion without stabilization of the acromion
MMT supraspinatus is painful and is 4/5 or less
MMT subscapularis is painful and is 4/5 or less
PROM, pain begins at 90° of abduction and continues to 180°
Reproduction of shoulder pain with manual examination of the scapulothoracic region, "exactly"
Latent SDIS
Shoulder pain is absent
+ or − reduced performance
painfree "popping and clicking" with active glenohumeral motion
Active ROM is painfree
+ or − Impingement sign
+ or − Hawkins sign
− Yergasons test
MMT of the supraspinatus if 4/5 without pain
MMT of the subscapularis is 4/5 without pain and with recruitment of the pectoralis major
Manual examination of the scapulothoracic region produces anterior or anterolateral shoulder pain

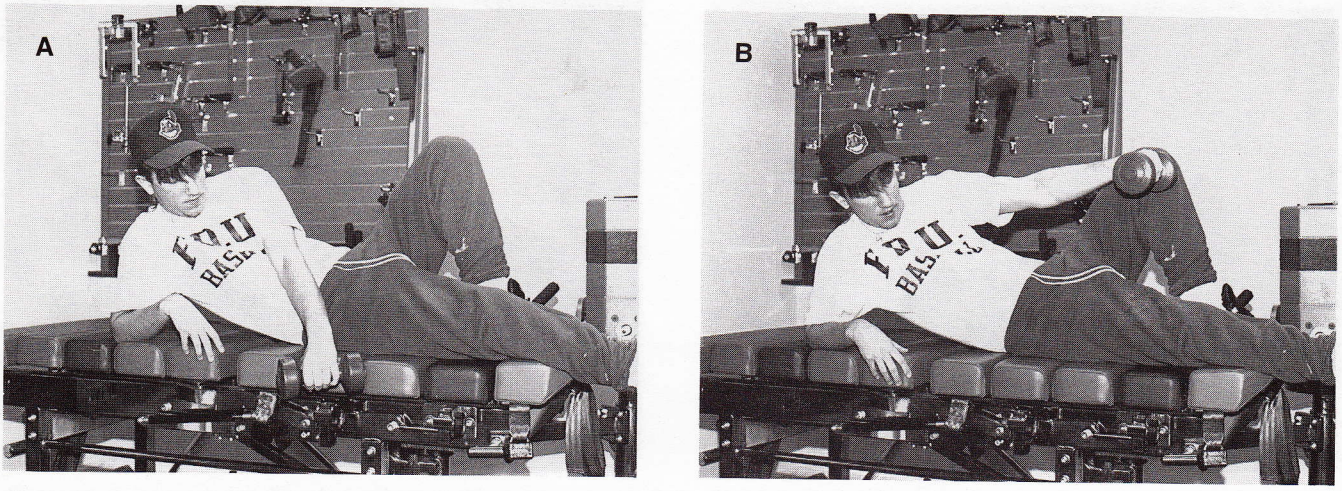


Figure 4. Strengthening of the supraspinatus. (A) Start. (B) Finish.

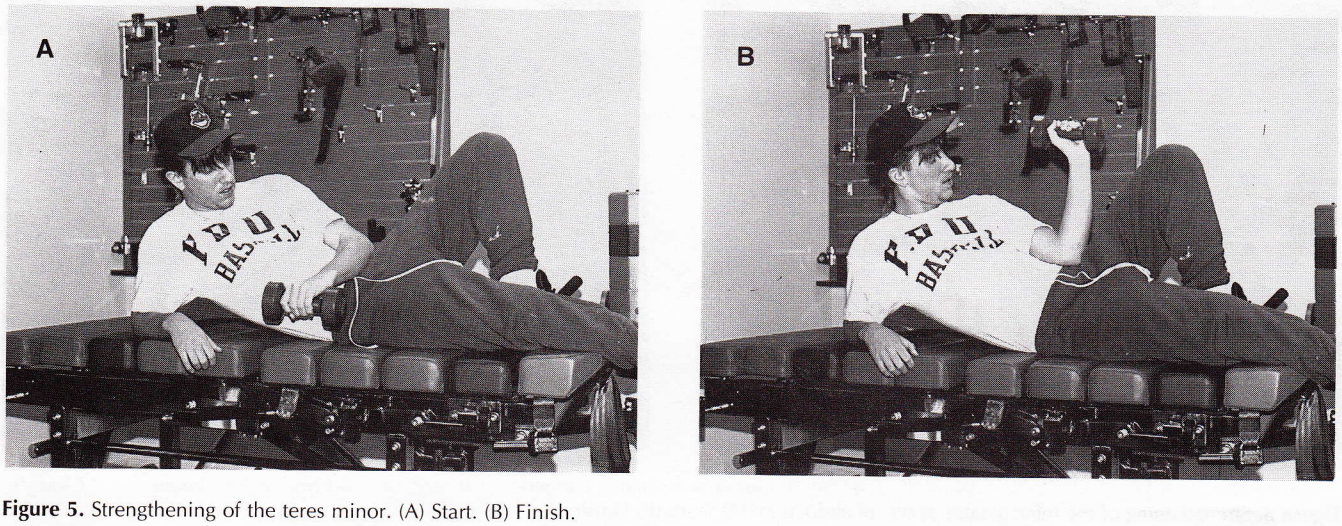


Figure 5. Strengthening of the teres minor. (A) Start. (B) Finish.

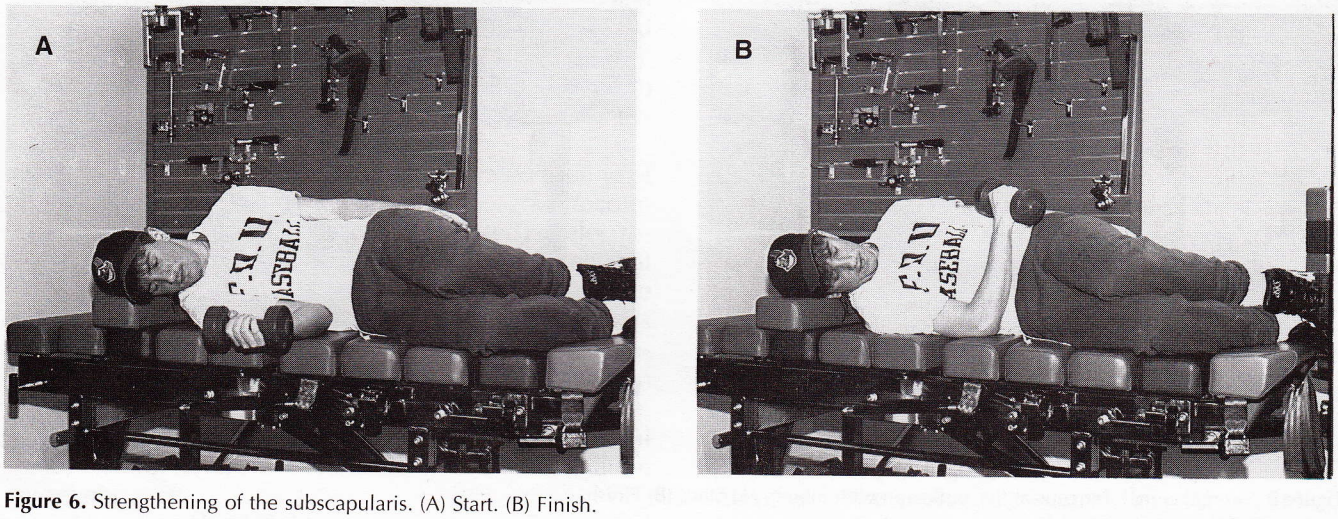


Figure 6. Strengthening of the subscapularis. (A) Start. (B) Finish.

A comprehensive exercise rehabilitation program was initiated immediately (1,3,8,20–24). The following principles were the basis of our rehabilitation program: 1) strengthening the rotator cuff muscles, with special attention being paid to the external rotators (21–25); 2) exercising the rotator cuff muscles without entering the impingement zone.

The patient was instructed on the performance of

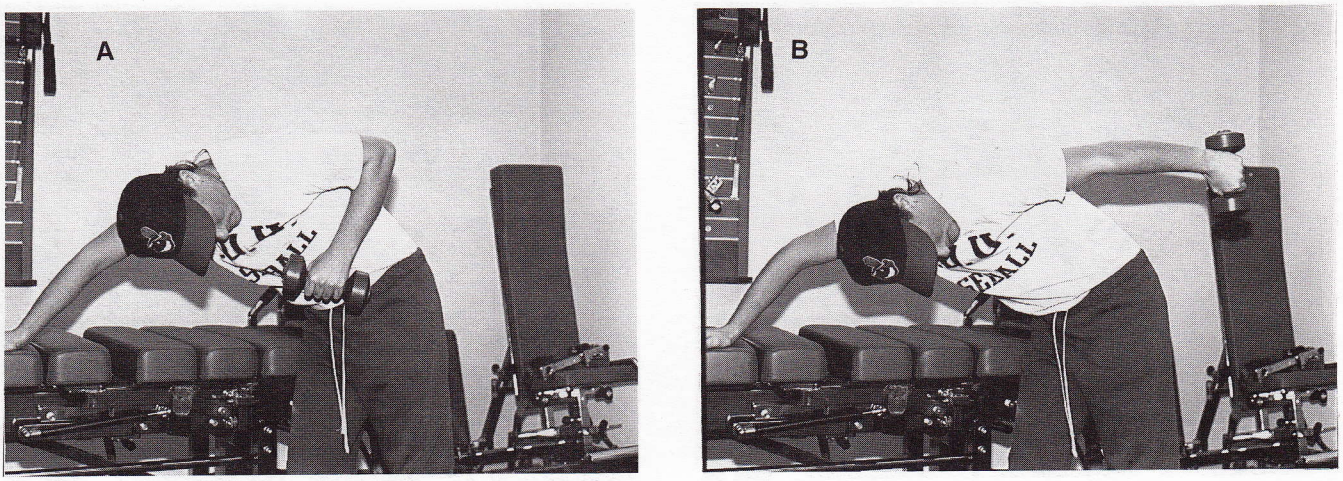


Figure 7. Triceps kickback with dumbbell. (A) Start. (B) Finish.

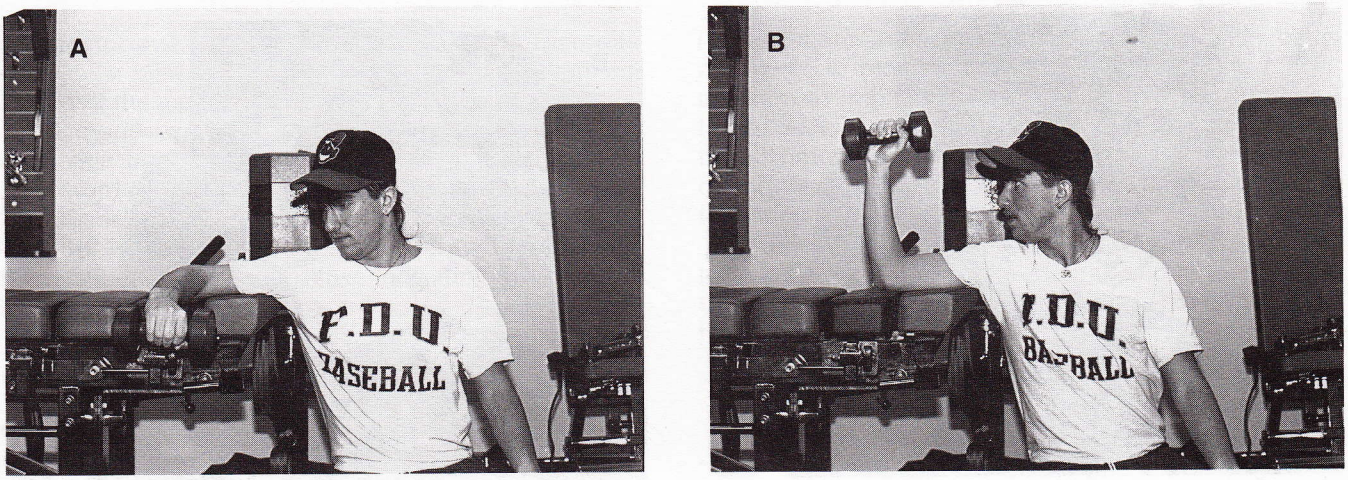


Figure 8. Strengthening of the infraspinatus at 90° of abduction. (A) Start. (B) Finish.

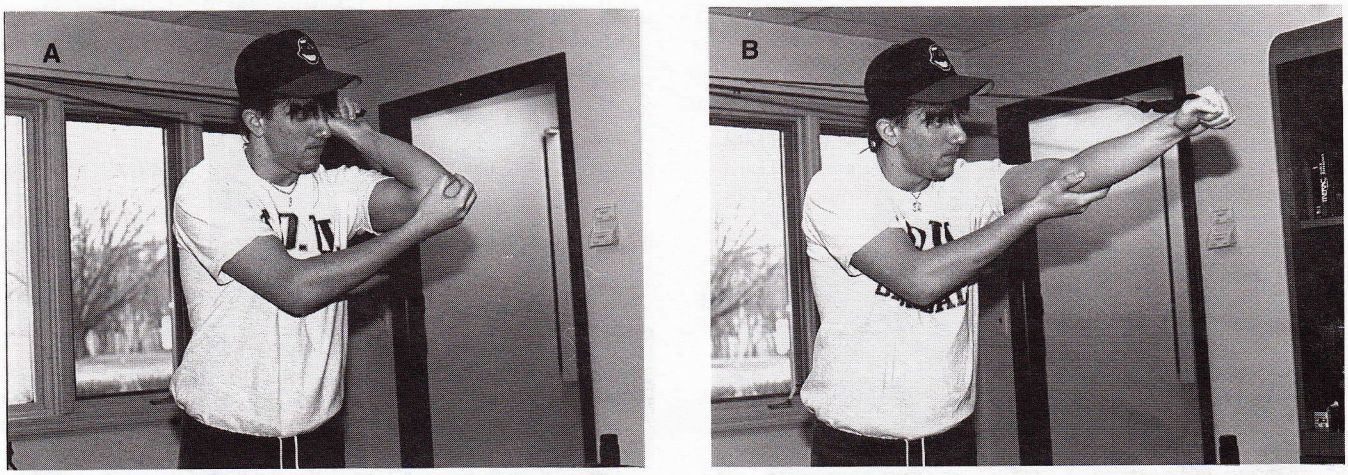


Figure 9. Strengthening of triceps at 90° of flexion with tubing. (A) Start. (B) Finish.

four initial exercises (8,9) as illustrated (Figs. 4–7). Initially, the exercises were performed at 20 repetitions per exercise one time per day using a 5-pound dumbbell. This was followed by increasing them to two times per day and finally three times per day. As he became more comfortable (1,23) with the exercises, the repetitions were first increased to 25 and later 30 repetitions per exercise.

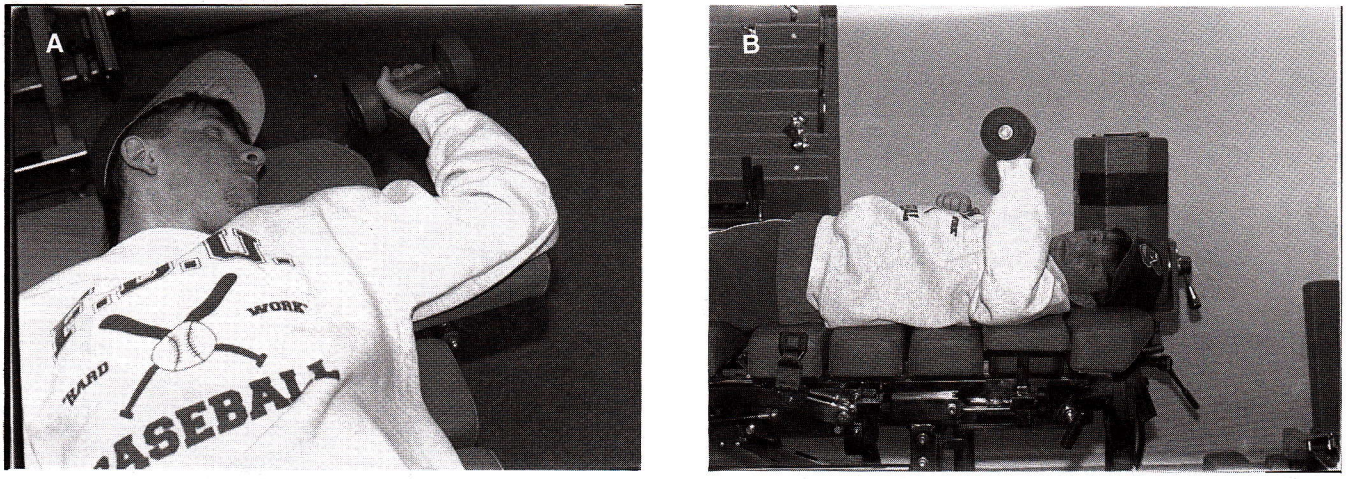


Figure 10. Strengthening of the subscapularis at 90° of abduction. (A) Start. (B) Finish.

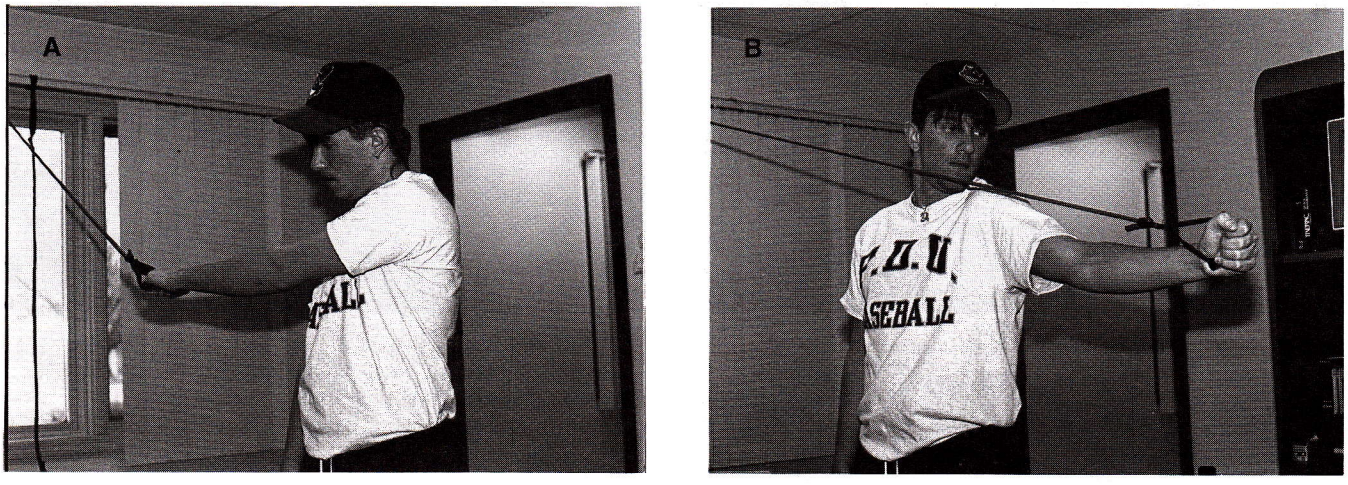
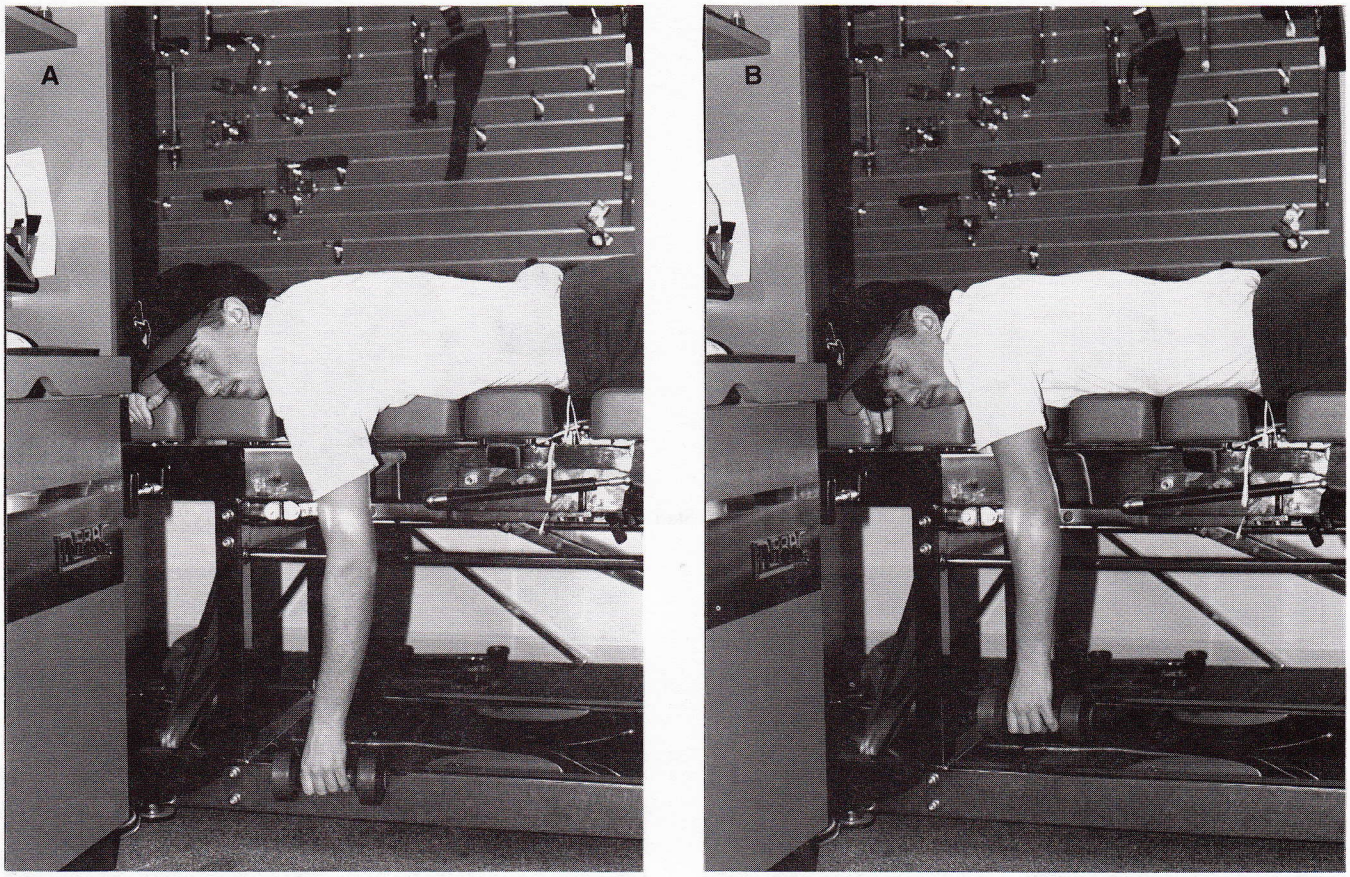


Figure 11. Advanced straight arm exercise. Standing horizontal extension with tubing. (A) Start. (B) Finish.

As the impingement sign (4,12) and Hawkins sign (12) failed to produce pain, further exercises were added to include advancement in the range of motion (ROM). When approaching 90° of flexion or abduction, attention was given not to cause internal rotation and not to exceed 90° (Figs. 8 and 9).

The author uses the previously illustrated routine of exercises over that of the more popular program recommended by Townsend et al., which is based on electromyogram (EMG) analysis (26). It should be noted that the EMG analysis of Townsend et al. did not include the illustrated methods of strengthening the supraspinatus (Fig. 4): external rotation at ~ 90° abduction for the infraspinatus (Fig. 8) and internal rotation at ~ 90° abduction for the subscapularis (Fig. 10). EMG analysis of the rotator cuff muscles in these positions may provide useful data, leading to refinement of rotator cuff rehabilitation programs.

The "core" (25) of the program of Townsend et al. includes 1) elevation in the scapular plane with the thumbs down (26). In essence, this exercise reproduces the mechanism of internal rotation, abduction, and flexion or the mechanism of reproducing impingement (5,27,28). This position is extremely useful in testing the supraspinatus, because straight alignment of the musculotendinous insertion allows for isolation of the supraspinatus (5); exercising in this position, however, can only lead to further microtrauma and is therefore not recommended. 2) The program also includes full forward flexion (26). This motion reproduces that of the impingement sign (27,28). Without the removal of the scapulothoracic adhesion, the acromion would be deficient in its elevation, causing impingement and further microtrauma. 3) In addition, horizontal abduction with arms externally rotated is used. Players with impingement or rotator cuff injury are delinquent in the force couple mechanism. Horizontal abduction under load without first reestablishing the force couple (6,8) and synergism within the rotator cuff will result in repetitive shear force, resultant microtrauma, and morbid outcome. 4) Another exercise is the press-up. Because this did not induce impingement, it was acceptable but felt to be primarily proprioceptive in nature. For reasons stated, this author does not recommend what Townsend et al. have recommended, i.e., "that the minimum for an effective and succinct rehabilitation protocol for the glenohumeral



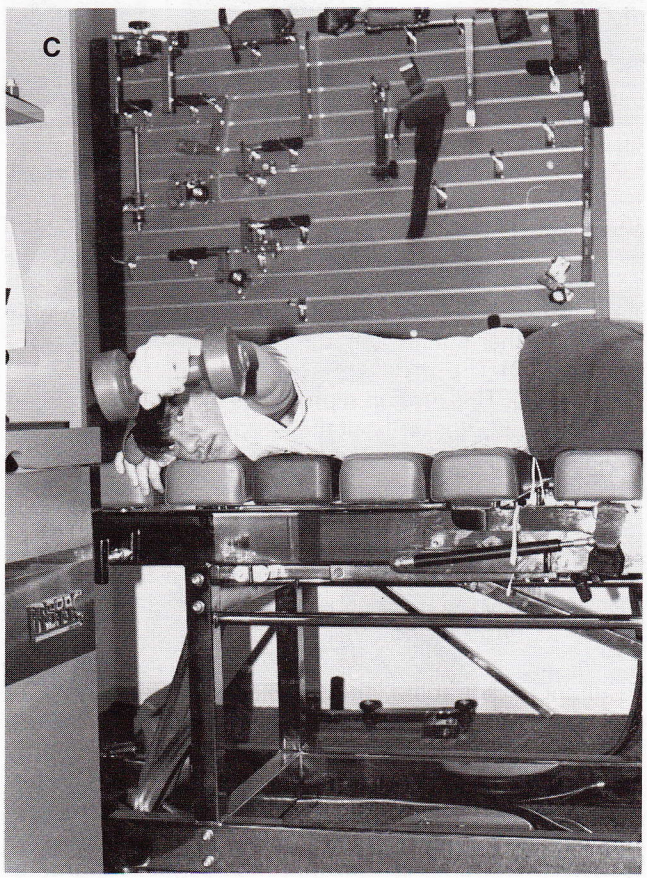


Figure 12. Advanced straight arm exercise. Prone scapular retraction and depression, followed by horizontal extension. (A) Start. (B) Scapular shrug. (C) Horizontal extension.

muscles would include these exercises" (26).

The "core" exercises illustrated here differ from the more accepted EMG-based program in that they keep the patient exercising below the impingement level during the symptomatic phase. As scapulothoracic adhesion is resolved and proper elevation of the acromion and adequate force couple are restored, straight arm exercises are added while again avoiding the impingement zone (Figs. 11 and 12). Care is also taken to prevent reproduction of the impingement mechanism (abduction with internal rotation) (5).

Isokinetic technology has been used and also abused in the rehabilitation of rotator cuff injuries, both conservative and postsurgical (23,29,30). Too often, the isokinetic device is used either too early or as the sole rehabilitative strengthening tool. The author feels that because of the fragile nature of the external rotator muscles, the rapid change in direction required in isokinetic exercise will overload the rotator cuff, thus causing further injury.

However, isokinetic technology can be used as a conditioning tool in combination with other training methods (but never as the sole training device) (23) once the outlined criteria have been met (Table 2).

When these criteria have been met, early rehabilitative throwing and isokinetic conditioning (23) can commence. Under no circumstances should the **painful**

Table 2
Criteria for beginning isokinetic conditioning

ROM is full and painfree in all planes
Orthopaedic tests are negative
MMT of the SITS muscles is 5/5 without pain
Absence of referred pain on manual examination of the scapulothoracic region
All rotator cuff exercises outlined can be performed twice daily, 30 repetitions per exercise with a 5-pound dumbbell

shoulder of a throwing athlete be exercised isokinetically. This will undoubtedly result in a morbid outcome. If pain should arise during isokinetic training, the session should be aborted and the athlete's shoulder reevaluated.

CONCLUSION

The previously illustrated case of SDIS is not, by far, an isolated case. The author has had the opportunity to examine approximately 35 high school- and college-aged baseball players (pitchers primarily) with and without a history of shoulder pain. SDIS was found in all but one player (this player had a true biceps tendonitis) in either an active form (currently had shoulder pain that was reproducible on examination) or latent form (no history of shoulder pain, yet examination produced shoulder or upper extremity pain and rotator cuff weakness was evident). In examining the competitive throwing athlete, several principles must be remembered: 1) the lesion must first be suspected if it is to be found (8); 2) an extremely high percentage of throwing athletes of all ages (2,7) will develop SDIS; 3) examination of the throwing athlete must include aggressive manual methods, paying close attention to the scapulothoracic region not just to the glenohumeral joint; 4) early diagnosis of SDIS will allow for preventive treatment and rehabilitation, reducing the risk for catastrophic injury; 5) rehabilitation must be performed below the impingement level and progress systematically to completion (1,23).

By following the principles of examination, treatment, and rehabilitation outlined, one can prevent the majority of baseball-related rotator cuff injuries. Players thought to be at career end, players having failed recovery via traditional conservative care, or players with reduced velocity and/or poor control should be examined for SDIS, and their rehabilitation programs should be reassessed.

References

1. Michaud T. Biomechanics of unilateral overhand throwing motion: an overview. Chiropract Sports Med 1990;4:14–26.
2. Sisto DJ, Jobe FW. The operative treatment of scapulothoracic bursitis in professional pitchers. Am J Sports Med 1986;14:192–194.
3. Roy S, Irvin R. Sports medicine: prevention, evaluation, management and rehabilitation. Englewood Cliffs, New Jersey: Prentice-Hall, 1983:211–216.
4. Watson K. Impingement and rotator cuff lesions. In: Nicholas JA, Hershman EB, eds. The upper extremity in sports medicine. St. Louis: CV Mosby, 1990:213, 217, 224.
5. Kulund DN. The injured athlete. 2nd ed. Philadelphia: JB Lippincott, 1988:303–311, 317, 330, 346–352.
6. Hammer WI. Functional soft tissue examination and treatment by manual methods: the extremities. Gaithersburg, Maryland: Aspen 1991:27–29, 34, 45, 48.
7. Haney TC. Subscapular elastofibroma in a young pitcher: a case report. Am J Sports Med 1990;18:642–644.
8. Leahy PM, Mock LE. Altered biomechanics of the shoulder and the subscapularis. Chiropract Sports Med 1991;5:62–66.
9. Leahy PM, Mock LE. Synoviochondrometaplasia of the shoulder: a case report. Chiropract Sports Med 1992;6:5–9.
10. Leahy PM, Mock LE. Myofascial release technique and mechanical compromise of peripheral nerves of the upper extremity. Chiropract Sports Med 1992;6:139–150.
11. Ryu RK, McCormick J, Jobe FW, et al. An electromyographic analysis of shoulder function in tennis players. Am J Sports Med 1988;16:481–485.
12. Gambardella RA, Jobe FA. Diagnosis and treatment of shoulder injuries in throwers. In: Nicholas JA, Hershman EB, eds. The upper extremity in sports medicine. St. Louis: CV Mosby, 1990:755–757.
13. Mennell JMM. The musculoskeletal system: differential diagnosis from symptoms and physical signs. Gaithersburg, Maryland: 1992:21–22.
14. Hoppenfeld S. Physical examination of the spine and extremities. East Norwalk, Connecticut: Appleton-Century-Crofts, 1976:34.
15. Mazion JM. Illustrated manual of neurological reflexes/signs/tests and orthopedic signs/tests/maneuvers for office procedure. Casa Grande, Arizona: Mazion, 1980:362–363.
16. American Academy of Orthopaedic Surgeons. Athletic training and sports medicine. Park Ridge, Illinois: American Academy of Orthopaedic Surgeons, 1991:248–251.
17. Jackson BA, Schwane JA, Starcher BC. Effect of ultrasound therapy on the repair of Achilles tendon injuries in rats. Med Sci Sports Exerc 1991;23:171–176.
18. Sullivan PE, Markos PD, Minor MD. An integrated approach to therapeutic exercise: theory and clinical application. Reston, Virginia, 1982:140.
19. Kirk CR, Lawrence DJ, Valvo NL. States manual of spinal pelvic and extravertebral technics. 2nd ed. Lombard, IL: National College of Chiropractic, 1985:47, 67, 80, 81, 82.
20. Mendoza FX, Nicholas JA, Sands A. Principles of shoulder rehabilitation in the athlete. In: Nicholas JA, Hershman EB, eds. The upper extremity in sports medicine. St. Louis: CV Mosby, 1990:251.
21. Jobe FW, Tibone JE, Perry J, Moynes DR. An EMG analysis of the shoulder in throwing and pitching: a preliminary report. Am J Sports Med 1983;11:3–5.
22. Jobe FW, Moynes DR, Tibone JE, Peery J. An EMG analysis of the shoulder in pitching: A second report. Am J Sports Med 1984;12:218–220.
23. Pappas AM, Zawacki RM, McCarthy CF. Rehabilitation of the Pitching Shoulder. Am J Sports Med 1985;13:223–235.
24. Jobe FW, Moynes DR. Delineation of diagnostic criteria and a rehabilitation program for rotator cuff injuries. Am J Sports Med 1892;10:336–339.
25. Middleton K. Prevention and rehabilitation of shoulder injuries in throwing athletes. In: Nicholas JA, Hershman EB, eds. The upper extremity in sports medicine. St. Louis: CV Mosby, 1990:775.
26. Townsend H, Jobe FW, Pink M, Perry J. Electromyographic analysis of the glenohumeral muscles during a baseball rehabilitation program. Am J Sports Med 1991;19:264–272.
27. Hawkins RJ, Abrahms JS. Impingement syndrome in the absence of rotator cuff tear (stages 1 and 2). Orthop Clin North Am 1987;18:373–382.
28. Neer CS II. Impingement lesions. Clin Orthop 1983;173:70–77.
29. Ivey FM, Jr, Calhoun JH, Rusche K, Bierschenk J. Isokinetic testing of shoulder strength: normal values. Arch Phys Med Rehabil 1985;66:384–386.
30. Alderink GJ, Kuck DJ. Isokinetic shoulder strength of high school and college aged pitchers. J Orthop Sports Phys Ther 1986;7:163–172.
31. Redler MR, Ruland LJ, III, McClue FC, III. Quadrilateral space syndrome in a throwing athlete. Am J Sports Med 1986;14:511–513.