

Treatment of Instability of the Shoulder with an Exercise Program*

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ABSTRACT: One hundred and forty shoulders in 115 patients that had a diagnosis of traumatic or atraumatic recurrent anterior, posterior, or multidirectional subluxation were treated with a specific set of muscle-strengthening exercises. Only twelve (16 per cent) of the seventy-four shoulders (sixty-eight patients) that had traumatic subluxation had a good or excellent result from the exercises, compared with fifty-three (80 per cent) of the sixty-six shoulders that had atraumatic subluxation. For this reason, each patient who has instability of the shoulder should be thoroughly evaluated if a successful result from conservative treatment is to be expected. Every effort must be made to identify the etiology of the instability through careful history-taking, physical examination, and radiographic evaluation.

Traumatic anterior subluxation, as opposed to dislocation of the shoulder, was described by Blazina and Satzman in 1969. They reported on thirty-seven shoulders in thirty-four patients; twenty-four shoulders that had recurrent subluxation were operated on. Trauma was the initiating factor of most of the injuries. Radiographs of eleven shoulders were normal; abnormalities of the humeral head and the glenoid were seen on radiographs of the others. Of the twenty-four shoulders that were operated on, 66 per cent had an avulsion of the glenoid labrum, and in the rest, there was a defect of the humeral head or the capsule. The authors reported a close relationship between recurrent subluxation and recurrent dislocation, and there was an unsatisfactory result in three of the twenty-four shoulders that were operated on. The authors did not describe the operative procedure.

In 1956, Rowe divided shoulder dislocations into two groups: traumatic and atraumatic¹⁴. He reported on 488 patients who had 500 dislocated shoulders; 4 per cent of the dislocations had an atraumatic etiology, and 96 per cent were the result of trauma. The atraumatic dislocations resulted from a minor incident, such as simply

raising the arm, or positioning during sleep. Hypermobile joints were a frequent finding in patients who had an atraumatic dislocation. In 1973, Rowe et al. reported on twenty-six patients who had voluntary dislocation of the shoulder. Most of their patients responded to muscle-strengthening exercises, but patients who had appreciable psychiatric problems did poorly with all types of operative and non-operative treatment¹⁷.

The importance of the difference between the diagnosis and treatment of patients who have traumatic or atraumatic instability has been previously stressed by one of us⁷; in subsequent reports, a classification for subluxations of the glenohumeral joint was described^{7,9,12}. Type I is a traumatic subluxation without previous dislocation; Type II, a traumatic subluxation after previous dislocation; Type IIIA, an atraumatic, voluntary subluxation in patients who have psychological problems; Type IIIB, an atraumatic, voluntary subluxation in patients who do not have psychological problems; and Type IV, involuntary subluxation.

Transient traumatic subluxation of the shoulder was reported by Rowe and Zarins¹⁶ in 1981 and by Rowe¹⁵ in 1987. The patients in these series felt a sharp or paralyzing pain in the shoulder after maximum external rotation in elevation or after a direct blow. The authors coined the term dead-arm syndrome to describe the symptoms associated with this injury. Some patients noted the sensation of subluxation when the arm was externally rotated, and some were not aware of the subluxation. In both series^{15,16}, the patients were initially treated with specific resistance exercises to strengthen the muscles of the rotator cuff. In the earlier series, treatment was non-operative; the fifty shoulders that did not respond favorably to the exercise regimen were treated with a modified Bankart repair¹⁶.

In 1980, Neer and Foster reported on thirty-six patients who had involuntary inferior and multidirectional subluxation and dislocation of the shoulder that had failed to respond to a previous standard reconstruction of the shoulder. All of the patients were treated initially by psychiatric evaluation and strengthening exercises for the shoulder and finally by a specific inferior capsular-shift procedure.

The purpose of this paper is to report on the effect of a specific rehabilitation program for the shoulder on a

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TABLE I
DATA ON THE PATIENTS

Type of Subluxation	No. of:		Male/Female Patients	Average Age (Yrs.)	Dominant Shoulder	Bilateral Instability	Generalized Ligamentous Laxity
	Shoulders	Patients					
Traumatic							
Type I	40	37	33/4	20	19 (48%)	3 (8%)	0
Type II	34	31	28/3	31	18 (53%)	3 (10%)	0
Atraumatic							
Type IIIA	5	5	2/3	21	2	3	5
Type IIIB	16	10	5/5	24	13	3	16
Type IV	45	32	14/18	27	32 (70%)	18 (40%)	45 (100%)

group of patients who had traumatic or atraumatic and multidirectional instability of the shoulder.

Materials and Methods

The cases of 115 patients (140 shoulders) were available for review. In addition to the hospital charts, the preoperative and postoperative radiographs were available. Eighty-seven patients were evaluated at follow-up by the senior one of us (C. A. R., Jr.), and twenty-eight patients either were contacted by telephone or filled out a detailed questionnaire concerning the results of the rehabilitation program; thirteen patients who responded to the questionnaire were also personally evaluated. The patients were followed for an average of forty-six months (range, two to six years).

The diagnosis and classification of the shoulders into the traumatic and atraumatic groups was based on a carefully taken history, a physical examination, and evaluation of radiographs. The pertinent questions that were asked concerned the initial episode, the amount of trauma involved, the position of the arm when the injury occurred, and the amount of pain involved at the time of the injury and after the injury. The physical examination included the range of motion of the shoulder, the stability of the shoulder, and whether or not apprehension was present during testing for anterior-posterior or inferior instability. Anterior and posterior (with the arm in internal and exterior rotation), axillary lateral, West Point axillary lateral¹³, and notch radiographs⁵ were made for all patients¹¹. In recent years, an apical oblique radiograph, as described by Garth et al., has been made to identify osseous changes in the glenoid labrum and the humeral head. Stress radiographs also were made when inferior instability was suspected.

Traumatic Subluxation

Type I — without previous dislocation: Thirty-seven patients (forty shoulders) had traumatic subluxation with no previous dislocation of the shoulder (Table I). Thirty-three patients were male and four were female, and the average age was twenty years (range, fifteen to thirty-eight years). Nineteen shoulders were on the dominant side, and both extremities were involved in three

patients (8 per cent). In four patients (six shoulders), the traumatic subluxation was posterior, and in the remaining thirty-three patients (thirty-four shoulders), it was anterior.

Type II — with previous dislocation: In thirty-one patients (thirty-four shoulders), dislocation of the shoulder had preceded the symptoms of subluxation. There were twenty-eight men and three women; the average age was thirty-one years (range, eighteen to forty-two years). The dominant extremity was involved in eighteen patients (53 per cent) and both shoulders, in three patients (10 per cent). Twenty-nine dislocations were anterior and five were posterior.

Atraumatic Subluxation

Type IIIA — voluntary subluxation and psychological problems: In the course of the evaluation and rehabilitation program, five patients (five shoulders) were found to have appreciable psychological problems. Three patients were female and two were male; the average age was twenty-one years (range, twelve to thirty-six years). The dominant extremity was involved in two patients and both shoulders, in three. Three dislocations were anterior and two were posterior. All patients had generalized ligamentous laxity.

Type IIIB — voluntary subluxation and no psychological problems: Ten patients (sixteen shoulders) had voluntary subluxation and no psychological problems. In six shoulders, the subluxation was posterior and in four, it was anterior; the instability was multidirectional in six shoulders. Five patients were male and five were female, and the average age was twenty-four years (range, thirteen to thirty-four years). The dominant extremity was involved in thirteen patients and both shoulders, in three. All of the patients had generalized ligamentous laxity.

Type IV — involuntary subluxation: Thirty-two patients (forty-five shoulders) had involuntary subluxation. Eight shoulders had posterior instability, four shoulders had anterior instability, and thirty-three shoulders had multidirectional instability. Fourteen patients were male and eighteen were female; the average age was twenty-seven years (range, twelve to fifty-four years). The dominant extremity was involved in thirty-two patients

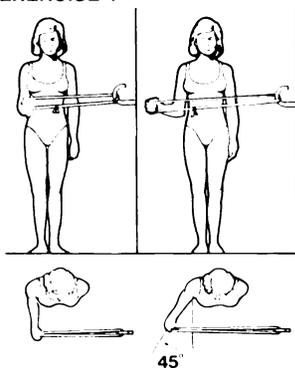
Shoulder Strengthening Exercises

Shoulder Service—Department of Orthopaedics
The University of Texas Health Science Center
at San Antonio

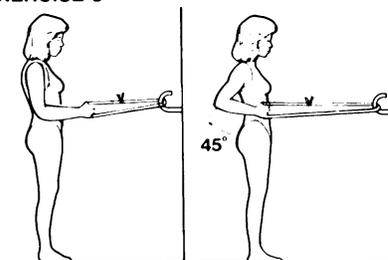
Do each exercise _____ times. Hold each
time for _____ counts. Do exercise program
_____ times per day.

Begin with Yellow Theraband for _____ weeks.
Then use Red Theraband for _____ weeks.
Then use Green Theraband for _____ weeks.
Then use Blue Theraband for _____ weeks.
Then use Black Theraband for _____ weeks.
Then use Gray Theraband for _____ weeks.

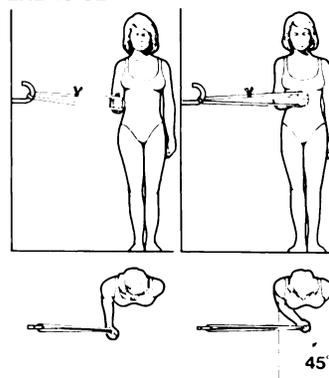
EXERCISE 1



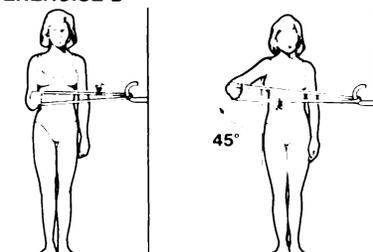
EXERCISE 3



EXERCISE 4



EXERCISE 2



EXERCISE 5

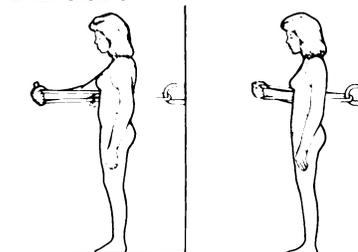


FIG. 1-A

Figs. 1-A and 1-B: A specific rehabilitation program to strengthen the deltoid, rotator cuff, and scapular stabilizer muscles. (Reprinted, with permission, from Young, D. C., and Rockwood, C. A., Jr.: Complications of a failed Bristow procedure and their management. *J. Bone and Joint Surg.*, 73-A: 972, 973, Aug. 1991.)

Fig. 1-A: Initially, the patient is given rubber Therabands (Hygenic, Akron, Ohio) to strengthen the muscles of the rotator cuff and the three parts of the deltoid.

(71 per cent) and both shoulders, in eighteen (40 per cent). All of the patients had generalized ligamentous laxity.

Radiographic Findings

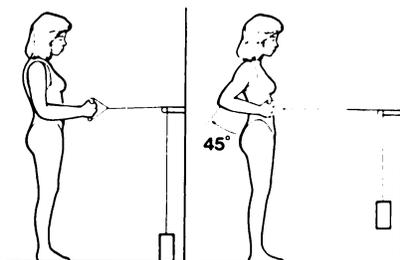
Radiographic changes in the humeral head or glenoid were noted in twenty-two (55 per cent) of the shoulders that had Type-I (traumatic) instability and in twenty-seven (79 per cent) of the shoulders that had Type-II (traumatic) instability. The radiographic changes in the shoulders that had Type-I subluxation included a chip fracture or calcification on the anterior or antero-inferior aspect of the glenoid rim. In Type-II subluxations, the same fracture or calcification of the glenoid was noted, as well as evidence of the old dislocation, such as the presence of a posterolateral compression fracture of

the humeral head (Hill-Sachs lesion) or the presence of a screw or staple that had been used in a previous operation, or both. None of the twenty-one shoulders that had Type-III (atraumatic) instability had radiographic evidence of injury to the glenohumeral joint. Four (9 per cent) of the patients who had Type-IV (atraumatic) subluxation had radiographic evidence of a subtle rounding-off of the anterior portion of the glenoid rim.

Rehabilitation Program

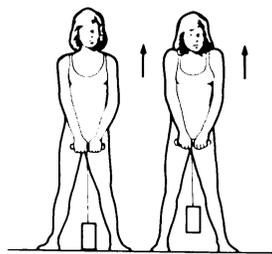
After the cause of the instability had been evaluated and classified, the patients began performing a specific set of exercises designed to strengthen the deltoid and the muscles of the rotator cuff. This program has been previously described¹⁰ and is based on the principle of progressive resistance. The first phase of the resistance

Pulley kit and weight exercise

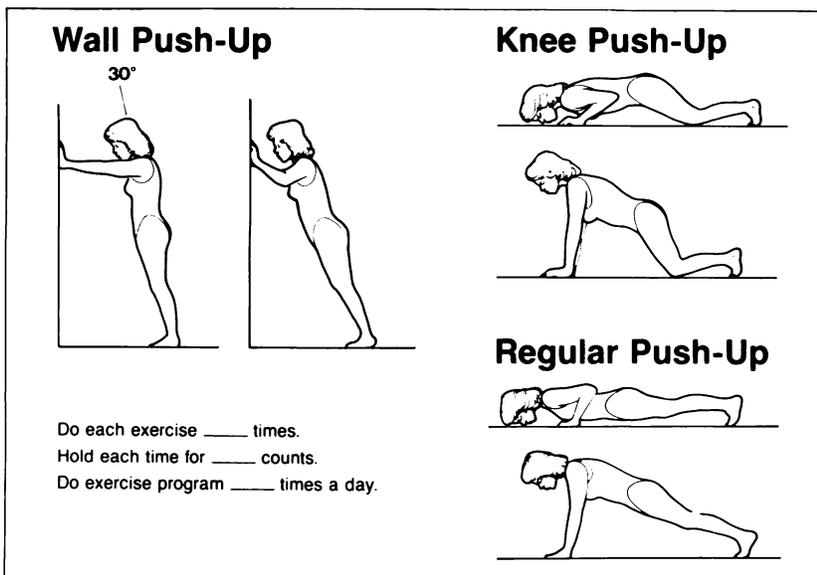


Do each exercise _____ times.
 Hold each time for _____ counts.
 Do exercise program _____ times a day.
 Begin with 10 lbs. of weight and add
 3 lbs. every three weeks until _____ lbs.
 of weight are obtained.

Shoulder Shrug



Do each exercise _____ times.
 Hold each time for _____ counts.
 Use _____ pounds of weight.
 Do exercise program _____ times a day.



Do each exercise _____ times.
 Hold each time for _____ counts.
 Do exercise program _____ times a day.

FIG. 1-B

When the patient is proficient with exercises 1 through 5, exercises are begun with a kit that consists of a pulley, hook, rope, and handle. The pulley is attached to the hook, which is fixed to the wall, and the five exercises are performed. Initially, the patient is instructed to use five or ten pounds (two or five kilograms) of weight; this is gradually increased over a period of several months to as much as twenty-five pounds (eleven kilograms). The purpose of the five exercises is to strengthen the three parts of the deltoid muscles, the internal rotators, and the external rotators.

Recently, we have added exercises to strengthen the scapular stabilizer muscles. To strengthen the serratus anterior and rhomboids, the patient is instructed first to do wall push-ups, and to gradually begin knee push-ups and then regular push-ups. The shoulder-shrug exercise is used to strengthen the trapezius and levator scapulae muscles.

exercise program is accomplished with use of a set of rubber Therabands (Hygenics, Akron, Ohio). Each band is three inches (7.6 centimeters) wide and five feet (152 centimeters) long and is tied into a loop so it can be fastened to a fixed object such as a doorknob.

Six bands are available; each band provides increasing resistance, from one to six pounds (0.5 to 2.7 kilograms), at increments of one pound (0.5 kilogram). The bands are color-coded to show the resistance that each one provides.

The patients are instructed in the number of times the exercises are to be performed each day, the number of repetitions to be done, and the length of time that each exercise should be done before they progress to the next

exercise (Fig. 1-A). Each of the five exercises is done two to three times a day, five repetitions each time, and each exercise is held for a count of five. The usual interval before progression to the next band is two to three weeks, although patients are instructed not to progress to the next band if there is any discomfort when they exercise with the current band.

The second phase of strengthening begins after the patient has progressed through all of the bands. The patient is then instructed to do the same exercises but against eight to ten pounds (four to five kilograms) of weight, using a pulley kit (Fig. 1-B) consisting of a piece of nylon rope, one-eighth of an inch (three millimeters) in diameter; a handle; a pulley; and a hook. The patient

TABLE II
GRADING SYSTEM^{16*}

	Points
Function	
No limitation in sports or work; able to throw baseball and football; can swim crawl-stroke	50
No limitation in work; slight limitation in throwing baseball, serving forcefully in tennis, or swimming crawl-stroke; can throw football normally	35
Moderate limitation in overhead work, throwing baseball and football, swimming crawl-stroke, or serving in tennis	20
Marked limitation in throwing in all sports; unable to work with arm overhead	0
Pain	
None	10
Moderate	5
Severe	0
Stability	
Negative apprehension test, no subluxation	30
Negative apprehension test, but discomfort with arm in position of abduction and external rotation	15
Positive apprehension test and sense of subluxation	0
Motion	
Full range of motion	10
As much as 25 per cent loss of motion in any plane	5
More than 25 per cent loss of motion in any plane	0

*Excellent = 90 to 100 points, good = 70 to 89 points, fair = 40 to 69 points, and poor = 30 or fewer points.

pulls against the weight while doing the same five exercises as had been done with the bands, exercising two to three times a day, holding each exercise for a count of five, and doing five repetitions. When this amount of weight becomes easy for the patient, the weights are gradually increased by increments of two pounds (one kilogram). For men, the weights are increased to as much as twenty to twenty-five pounds (nine to eleven kilograms) and for women, to as much as fifteen pounds (seven kilograms). Any suitable weights can be used, or the patient can purchase the weights from a sporting-goods store.

It must be carefully explained to patients that they must not progress too rapidly with either the Therabands or the weights, as this will cause discomfort in the shoulder and will prevent proper strengthening of the muscles. We believe that it is important that the orthopaedist instruct the patient and direct the rehabilitation program; hence, we call this an orthotherapy rehabilitation program.

The patients were followed at intervals of six to eight weeks to observe their progress. After three to four months, if a patient who had no psychological problems reported that the instability had not improved, an operative procedure was recommended. An operation was never recommended or performed in patients who had voluntary subluxation and had psychological problems. These patients were referred to the care of a psychiatrist.

A grading system suggested by Rowe and Zarins¹⁶ was used to rate the results of the rehabilitation program (Table II).

Results (Table III)

Traumatic Subluxation

Type I — without previous dislocation: Of the thirty-four shoulders that had an anterior dislocation, only six (18 per cent) had a good result (three shoulders) or an excellent result (three shoulders). Of the six shoulders that had posterior instability, two had an excellent result and one, a good result.

Type II — with previous dislocation: Only three (9 per cent) of the thirty-four shoulders had a good or excellent result. Two (9 per cent) of the twenty-nine shoulders that had anterior subluxation and one (of the five shoulders that had posterior subluxation) had a good or excellent result. The two shoulders that had anterior instability and a good or excellent result had only mild degenerative changes and no Hill-Sachs lesion.

Over-all, only twelve (16 per cent) of the seventy-four shoulders that had traumatic subluxation had a good or excellent result after the exercise program.

Atraumatic Subluxation

Type IIIA — voluntary subluxation and psychological problems: Five patients had psychiatric treatment. Two patients were diagnosed as having a hysterical personality disorder; two, schizophrenia; and one, an adolescent adjustment reaction. The patient who had an adolescent adjustment reaction and one of the two patients who had a hysterical personality disorder had a good result from the rehabilitation program. The two patients who had schizophrenia and the other patient who had a hysterical personality disorder had had a previous operative reconstruction and did not respond to the rehabilitation program. Operative treatment was not offered to any of these patients.

Type IIIB — voluntary subluxation and no psychological problems: Fourteen of the sixteen shoulders had a good or excellent result. All of the shoulders that had posterior or multidirectional instability had a good or excellent result, whereas only two (50 per cent) of the four shoulders that had anterior instability had a good or excellent result.

Type IV — involuntary subluxation: Thirty-nine (87 per cent) of the forty-five shoulders had a good result (ten shoulders) or an excellent result (twenty-nine shoulders), in that the shoulder became stable and strong enough to enable the patient to return to normal activities without instability. The result was good or excellent in all of the eight shoulders that had posterior subluxation and in twenty-nine (88 per cent) of the thirty-three shoulders that had multidirectional instability. However, only two of the four shoulders that had predominantly anterior instability had a good or excellent result.

The patients who had Type-IV subluxation and a

TABLE III
RESULTS AFTER EXERCISE PROGRAM ACCORDING TO THE CLASSIFICATION OF SUBLUXATION^{7,9,12}

	Traumatic		Atraumatic		
	Type I (N = 40)	Type II (N = 34)	Type IIIA (N = 5)	Type IIIB (N = 16)	Type IV (N = 45)
Anterior					
No. of shoulders	34	29	3	4	4
Good or excellent result	6	2	1	2	2
Fair or poor result	28	27	2	2	2
Posterior					
No. of shoulders	6	5	2	6	8
Good or excellent result	3	1	1	6	8
Fair or poor result	3	4	1	0	0
Multidirectional					
No. of shoulders				6	33
Good or excellent result				6	29
Fair or poor result				0	4

good or excellent result after the rehabilitation program noted that the shoulder became stable at an average of five weeks (range, two to twelve weeks). Maximum stability of the shoulder was reached at an average of fourteen weeks (range, six to thirty-six weeks). There was no identifiable difference between the shoulders that responded and those that did not with respect to the age or sex of the patient, the duration of symptoms, or the radiographic findings.

It is very important, once a stable shoulder has developed through the rehabilitation program, that the exercises are still done at least two to three times a week. Some of the patients had recurrent symptoms when they stopped the exercises. The symptoms were once again eliminated when the strengthening program was resumed. This was particularly true for teen-agers. The degree of compliance with the rehabilitation program was measured by the ability of the patient to demonstrate the exercise routine accurately, recall which color of Therabands indicated strongest or weakest, and state which exercise was the most difficult to perform.

Discussion

The fact that exercises improve the dynamic stability of the shoulder and often can obviate the need for operative intervention is not a new concept. In 1936, Davis recommended conservative treatment for recurrent dislocation of the shoulder and reported that six of eight patients responded well to exercises. Aronen and Regan decreased the prevalence of recurrence of a single anterior traumatic dislocation of the shoulder to 25 per cent with a combination of isometric, isotonic, and isokinetic exercises. Yoneda et al. reported that, in 104 patients who had traumatic anterior dislocation, a satisfactory result was achieved in 82.7 per cent after use of a program of exercises for the shoulder.

We found a substantial difference in the number of satisfactory responses between patients who had traumatic and atraumatic instability. Of the shoulders that had traumatic instability (Type I or II), 15 per cent had

a good or excellent result; of the shoulders that had atraumatic subluxation (Type III or IV), 83 per cent had a good or excellent result. In this series, traumatic subluxation was accompanied by a high prevalence of radiographic changes in the joint. Patients who have atraumatic subluxation have, by definition, no serious initial injury, the assumption being that the shoulder capsule is stretched out either from trivial trauma or from repetitive microtrauma resulting from overuse.

In each subgroup, the patients who had posterior instability responded better than those who had anterior instability. Because many patients who have posterior instability have a component of hyperlaxity, it appears that muscle-strengthening exercises can accommodate for ligamentous and capsular laxity of the shoulder. In contrast, exercises cannot consistently restore stability to the glenohumeral joint when fixed osseous architectural changes have occurred. In the years since the completion of this study, patients also have been instructed in shoulder shrug and push-up exercises to strengthen the scapular stabilizer muscles (the trapezius, serratus anterior, and rhomboids) (Fig. 1-B).

The information that was gained from this study has helped us in the care of our patients. Patients who have a clear-cut history of a traumatic anterior injury and also have the tell-tale osseous changes on the glenoid rim or humeral head are told that the proposed rehabilitation program has only an 18 per cent chance of success. Some patients then elect to have a reconstructive procedure, but most of them prefer to try the specific orthotherapy rehabilitation program. Most patients who have traumatic instability, even those who have not responded to a previous exercise program, accept our data and begin the described rehabilitation. Patients who have a history and physical findings that are indicative of an atraumatic problem and who have no radiographic abnormalities in the shoulder joint are thrilled to learn that an operation is not imminent and that the rehabilitation program has a success rate of 83 per cent.

Unsatisfactory and occasionally disastrous results

have been reported when operations that are designed for traumatic instability of the shoulder are performed on patients who have atraumatic subluxation^{14,16}; these operations are the most common causes of failure of reconstructions of the shoulder in patients who have been referred to the senior one of us (C. A. R., Jr.)¹⁰. Because of the high rate of complications associated with a routine reconstructive procedure on a shoulder that has atraumatic and multidirectional subluxation, and because of the high rate of success of rehabilitation exercises for these problems, we recommend a trial of specific resistance strengthening exercises before reconstruction of the shoulder is considered. The fact that more than 80 per cent of the atraumatic subluxations in our patients responded to exercises is helpful in the encouragement

of patients to continue the exercise program. In addition, during the exercise program, the physician has ample time to determine if the patient has any additional complicating factors, such as psychological or psychiatric disorders, that could compromise the results even if the best reconstructive procedure is performed.

The value of any classification system lies in its ability to predict a response to a specific form of treatment or to guide in operative decision-making, or both. The classification that we used enables the physician to predict, with some accuracy, the response to exercises by patients who have traumatic and atraumatic subluxation of the shoulder.

Note. The authors thank John Brna, M.D., for help in reviewing the cases of several of the patients.

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