Examination of the Shoulder: The Past, the Present, and the Future

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Introduction

The examination of the shoulder complex is a challenge for many practitioners. For any musculoskeletal condition, especially one that is associated with the shoulder joint, it is important to obtain a thorough history and physical examination, both of which are essential to reaching a diagnosis. For many disease entities, a diagnosis can often be accurately reached without the use of imaging studies. However, when imaging studies are mandated and available, the pertinent history and the findings from the physical examination should be integrated with those studies for the purpose of reaching an accurate diagnosis that allows effective treatment, whether nonoperative or surgical. In addition, subjective information from the patient (such as the occurrence of night pain or pain only with motion) and information gained from objective measures during the physical examination facilitate both the pretreatment assessment and the outcome evaluation.

In 1934, in his classic book *The Shoulder,* Codman[1] was the first to specifically address conditions that affect the shoulder joint. Within the book, he provided a table to help clinicians distinguish various shoulder conditions based on the pertinent history and the findings on physical examination. That table (Fig. 1) is still clinically relevant today. Since that time, however, many changes have occurred in the appreciation of disease states that affect the shoulder and in the identification of their associated pathophysiology and physical findings. The clinician's armamentarium with regard to patient history and physical examination findings has also expanded, and these tools help the clinician to arrive at an accurate diagnosis and an effective treatment plan.

The main goal of our investigation was to contrast our current evidence-based knowledge of shoulder examination with the observations made by Codman[1]. Specifically, our goals were: (1) to review the current literature on specific disease states of the shoulder as they relate to the relevant history and physical examination, (2) to provide a summary of the clinical usefulness of the history and the physical examination findings for these conditions, (3) to review our experience with physical examination of the shoulder, (4) to create a modern version of Codman's table with use of current statistical methods, and (5) to speculate on the future roles of history and physical examination in the diagnosis and treatment of shoulder conditions.

Materials and Methods

Data Collection

In 1995, we began entering the information of patients who were undergoing shoulder surgery at our institution into a database that was designed to allow us to study preoperative, intraoperative, and postoperative data. (For our current study, we focused on the data gained from the patient's history and preoperative physical examination findings and how that data compared with the surgical findings[2-8].) All patients completed subjective outcome instruments, including the Short Form-36 (SF-36)[9], the American Shoulder and Elbow Surgeons shoulder scale[10], the University of California at Los Angeles (UCLA) shoulder scale[11], and the L'Insalata shoulder questionnaire[9,12]. Each patient then underwent a thorough physical examination either by the senior author (E.G.M.) or under his direct supervision[8]. This examination included range-of-motion measurements, strength testing, and provocative tests to elicit specific findings for specific diagnoses. All preoperative data were entered into the database.

The patients subsequently underwent surgery of the shoulder by the senior author, but not all had arthroscopic shoulder evaluations. For those who did, a data sheet was used to record the findings, and all intraoperative data were subsequently entered into the database.

For the current study, we reviewed the preoperative and intraoperative data of patients who were treated within the time period of April 1995 through July 2008, and we report on all 1913 patients whose records were found to be complete.

Diagnoses Analyzed

We studied the following diagnoses: rotator cuff disease (tendinosis or bursitis, partial-thickness tear, full-thickness tear, and subscapularis tear), acromioclavicular joint abnormalities, shoulder instability (anterior, posterior, and multidirectional), anterior and posterior lesions of the superior labrum, and

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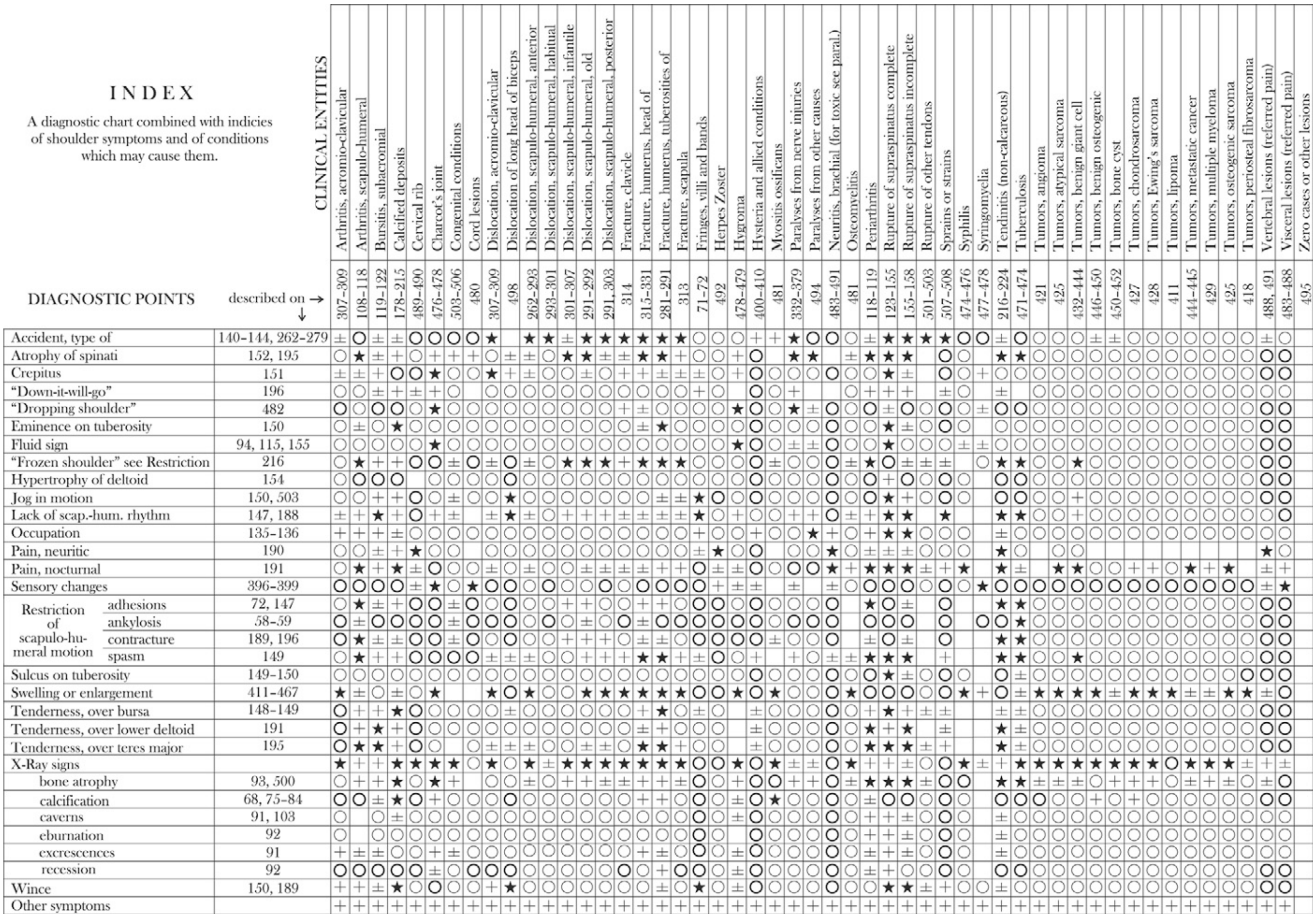

Fig. 1

Codman's table of shoulder abnormalities. Key: The numbers below the diagnoses refer to the pages on which the lesions are described; those in the vertical column, next to the list of diagnostic points, refer to the pages on which these points are explained. Thus the student, when using the chart, may readily obtain more information about dubious points. To use the chart to summarize the symptom-complex of any clinical entity, make separate lists of diagnostic points for each form or symbol in the vertical column under that entity, then write after each list as follows:

★ = (list) "are of positive importance in this diagnosis."

+ = (list) "are of positive importance, but not in all stages or in all cases."

± = (list) "are sometimes present but are often absent."

O = (list) "the presence of these would be contradictory to this diagnosis, so that their absence is important."

○ = (list) "are usually not present, but their presence is not important."

□ = (list) "the author has no opinion."

(Reprinted from: Codman EA. The shoulder. Rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Boston: Thomas Todd; 1934; with permission from Krieger Publishing Company.)

biceps tendon tears. For all patients, range-of-motion measurements were obtained with a hand-held goniometer with use of standard techniques: active abduction, active external rotation with the arm abducted to 90°, active internal rotation with the arm abducted to 90°, and active external rotation with the arm at the side[13].

We used the following diagnostic tests: the drop-arm sign[4], the shoulder shrug sign[7], the Neer impingement sign[14], the Hawkins-Kennedy impingement sign[15], the Speed test[16], the anterior apprehension test[17], the posterior apprehension test[18], the active compression test[19], the anterior slide test[20], the lift-off test[21], the anterior drawer test[22], the posterior drawer test[22], the painful arc sign[23], the cross-body adduction test[24], the acromioclavicular resisted extension test[2], the Whipple test[25], and the external rotation lag sign[26].

Statistical Analysis

For the current study, we analyzed the data to evaluate the clinical usefulness of history and physical examination factors in determining various shoulder diagnoses. For this study, we performed sensitivity, specificity, and likelihood ratio calculations only.

TABLE I Physical Examination Signs and Tests for the Shoulder from Our Database (Part A)*

	Range of Motion *(deg)*				Drop-Arm Sign			Shoulder Shrug Sign		
Diagnosis	ABD	90° ER	90° IR	ER Side	S *(%)*	Sp *(%)*	LR	S *(%)*	Sp *(%)*	LR
Rotator cuff	130.10	79.00	41.10	46.60	73.60	65.80	2.15	95.60	52.80	2.03
Tendinosis/bursitis	139.80	83.40	42.70	48.80	13.60	77.30	0.60	33.30	47.20	0.63
Partial-thickness tear	137.60	80.90	38.90	47.30	14.30	77.50	0.64	43.20	47.90	0.83
Full-thickness tear	126.60	78.20	40.80	46.80	34.90	87.50	2.79	62.10	52.60	1.31
Massive tear	108.20	65.10	36.00	37.50	43.80	82.30	2.48	74.50	49.80	1.49
Glenohumeral arthritis	86.30	49.30	14.40	22.00	22.10	81.80	1.22	90.50	56.80	2.10
Adhesive capsulitis	87.40	46.70	11.80	18.30	23.30	81.20	1.24	94.70	49.50	1.88
Glenohumeral instability	151.20	91.20	53.00	57.00	9.20	78.70	0.43	17.20	38.80	0.28
Anterior	152.00	90.10	51.80	55.40	9.00	79.50	0.44	19.90	37.40	0.32
Posterior	145.10	89.40	61.40	60.90	5.60	80.80	0.29	16.10	42.20	0.28
Multidirectional	153.00	102.10	55.00	67.50	4.50	80.90	0.24	9.50	42.40	0.17
SLAP lesions	146.50	93.40	55.60	53.50	5.60	80.80	0.29	24.00	48.00	0.46
Biceps disease	124.20	77.50	41.70	39.20	0.00	81.00	0.00	0.40	99.50	0.76
AC joint arthritis	139.20	85.00	41.90	49.90	12.10	80.60	0.62	27.90	47.10	0.53

*Because the data in some cells represent subgroups of patients, not all denominators equal 1913 patients; ABD = active abduction; ER = active external rotation with arm abducted 90°; IR = active internal rotation with arm abducted 90°; ER Side = active external rotation, arm at side; S = sensitivity; Sp = specificity; LR = likelihood ratio; SLAP = superior labrum anterior and posterior; and AC = acromioclavicular.

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There was no external funding source for this paper.

Results

Tables I through V present the signs and the test results of the 1913 patients from our database. Summary tables from our literature review with regard to these various disclosures are presented in the Appendix.

Rotator Cuff Disease

It is difficult for clinicians to examine patients for the presence of rotator cuff disease because there are many different types of associated abnormalities (e.g., painful tendinopathy [no tear], partial tears on the bursal or joint side of the involved tendon, full-thickness tears, and massive tears). In addition, controversy exists over exactly what causes the pain of “impingement”[14,23,27-30].

Some authors have contended that the spectrum ranging from rotator cuff tendinopathy to full-thickness tears should be called “rotator cuff disease,” rather than impingement[31,32]. However, most studies of rotator cuff disease have divided these conditions into two groups: (1) tendinosis and partial-thickness rotator cuff tears (early stage of rotator cuff disease); and (2) full-thickness and massive rotator cuff tears. Therefore, these entities are presented as “bursitis” (painful tendinosis, or no rotator cuff tearing), partial-thickness tears, or full-thickness tears, while recognizing that there is a continuum of disease and symptoms that overlap.

Tendinosis (“Bursitis”) and Partial-Thickness Tears

Neer[14,23] postulated that the early stages of rotator cuff disease were inflammation and swelling of the specific rotator cuff tendon. Although the literature suggests that the Neer impingement sign[33,34] is very sensitive for the presence of painful tendinosis, this test is not specific for the presence of rotator cuff disorders. In his descriptions of the impingement sign, Neer[14,23] cautioned that pain elicited with passive flexion of the arm could be indicative of a wide range of shoulder conditions. The Hawkins-Kennedy impingement sign[35] has a sensitivity that is similar to that of the Neer sign, but it has a low specificity for the presence of rotator cuff disease. Neither of these signs has high sensitivity nor specificity for the presence of full-thickness rotator cuff tears[4].

Full-Thickness Tears (Supraspinatus, Infraspinatus)

The best physical examination signs for rotator cuff disease include weakness in external rotation, a positive drop-arm sign, and a painful arc of motion. If a patient is more than sixty years old and has these three signs, then there is a 91% chance of a full-thickness rotator cuff tear (likelihood ratio, 15)[4]. Another study suggested that if a patient was older than sixty years and had a positive Neer or Hawkins-Kennedy impingement sign with weakness in abduction, there was a 98% chance that the patient had a full-thickness rotator cuff tear[36].

Subscapularis Tendon Tears

Described tests for the subscapularis muscle and tendon are the lift-off test, the belly-press test, and the bear-hug test[21,37,38].

TABLE II Physical Examination Signs and Tests for the Shoulder from Our Database (Part B)*

	Neer Impingement Sign			Hawkins-Kennedy Sign			Speed Test		
Diagnosis	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR
Rotator cuff	63.70	43.40	1.12	71.2	41.8	1.22	47.3	62.8	1.27
Tendinosis/bursitis	85.70	49.20	1.69	75.7	44.5	1.36	33.3	69.8	1.10
Partial-thickness tear	75.40	47.50	1.44	75.4	44.4	1.36	33.3	70.6	1.13
Full-thickness tear	59.30	47.20	1.12	68.7	48.3	1.33	39.9	75.3	1.62
Massive tear	62.50	59.90	1.56	64.4	35.6	1.00	52.1	58.5	1.25
Glenohumeral arthritis	36.70	61.40	0.95	77.7	38.5	1.26	52.5	60.5	1.33
Adhesive capsulitis	39.80	65.70	1.16	60.4	35.4	0.94	26.3	57.6	0.62
Glenohumeral instability	60.50	30.70	0.87	37.9	28.8	0.53	22.4	53.1	0.48
Anterior	58.00	34.70	0.89	33.1	30.5	0.48	18.0	54.2	0.39
Posterior	50.90	27.70	0.70	41.0	35.0	0.63	33.3	57.8	0.79
Multidirectional	59.00	18.30	0.72	50.0	35.3	0.77	25.9	57.7	0.61
SLAP lesions	38.50	33.30	0.58	42.1	35.1	0.65	52.8	58.3	1.26
Biceps disease	64.00	41.00	1.09	55.0	38.0	0.89	50.0	67.0	1.51
AC joint arthritis	57.00	41.00	0.78	47.0	45.0	0.85	24.0	71.0	0.83

*Because the data in some cells represent subgroups of patients, not all denominators equal 1913 patients; S = sensitivity; Sp = specificity; LR = likelihood ratio; SLAP = superior labrum anterior and posterior; and AC = acromioclavicular.

All of these tests have been reported to be beneficial in diagnosing subscapularis dysfunction; however, they are of limited usefulness for patients who have stiff shoulders that do not allow independent movement of the glenohumeral joint (e.g., frozen shoulders or shoulders with severe arthritis).

Although some studies have indicated that the bear-hug and the modified belly-press test are helpful in diagnosing

TABLE III Physical Examination Signs and Tests for the Shoulder from Our Database (Part C)*

	Anterior Apprehension Test			Posterior Apprehension Test			Active Compression Test		
Diagnosis	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR
Rotator cuff	4.3	74.2	0.17	0.2	97.7	0.10	68.2	41.7	1.17
Tendinosis/bursitis	6.5	83.8	0.40	0.0	98.7	0.00	61.3	36.7	0.97
Partial-thickness tear	8.0	83.8	0.49	0.0	98.6	0.00	69.8	37.5	1.12
Full-thickness tear	2.4	80.6	0.12	0.0	98.3	0.00	67.8	38.4	1.10
Massive tear	2.8	84.0	0.17	0.0	98.6	0.00	73.0	37.4	1.17
Glenohumeral arthritis	3.2	82.0	0.18	0.9	98.6	0.67	66.1	37.6	1.06
Adhesive capsulitis	4.8	84.3	0.30	0.0	98.7	0.00	53.3	36.7	0.84
Glenohumeral instability	58.1	95.7	13.67	5.6	99.6	14.53	43.8	32.0	0.64
Anterior	72.0	96.0	20.22	3.4	99.0	3.53	39.5	33.1	0.59
Posterior	20.0	84.7	1.31	19.2	99.2	24.97	71.0	37.0	1.13
Multidirectional	42.9	85.1	2.87	17.6	33.5	0.26	41.7	36.5	0.66
SLAP lesions	2.8	84.3	0.18	3.0	98.8	2.48	47.0	55.0	1.04
Biceps disease	0.0	84.5	0.00	0.0	98.7	0.00	68.0	46.0	1.24
AC joint arthritis	4.1	83.7	0.25	0.0	98.6	0.00	41.0	95.0	8.20

*Because the data in some cells represent subgroups of patients, not all denominators equal 1913 patients; S = sensitivity; Sp = specificity; LR = likelihood ratio; SLAP = superior labrum anterior and posterior; and AC = acromioclavicular.

TABLE IV Physical Examination Signs and Tests for the Shoulder from Our Database (Part D)*

	Anterior Slide Test			Lift-Off Test			Painful Arc Sign		
Diagnosis	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR
Rotator cuff	14.0	76.4	0.59	9.5	78.9	0.45	67.3	49.7	1.34
Tendinosis/bursitis	22.0	81.4	1.18	0.0	84.6	0.00	70.6	46.9	1.33
Partial-thickness tear	18.5	81.2	0.99	3.7	84.0	0.23	67.4	47.0	1.27
Full-thickness tear	11.0	78.5	0.51	9.6	82.8	0.56	75.8	61.8	1.98
Massive tear	5.6	80.5	0.29	27.8	85.8	1.96	76.4	42.6	1.33
Glenohumeral arthritis	33.2	84.3	2.12	28.9	89.4	2.73	71.4	44.9	1.30
Adhesive capsulitis	6.7	80.9	0.35	0.0	84.8	0.00	63.0	41.7	1.08
Glenohumeral instability	14.4	80.1	0.72	7.7	84.0	0.48	22.9	32.8	0.34
Anterior	14.1	80.5	0.72	4.0	84.1	0.25	19.7	35.4	0.30
Posterior	25.0	81.3	1.34	25.0	85.3	1.70	23.3	40.8	0.39
Multidirectional	9.1	81.0	0.48	0.0	84.9	0.00	23.8	41.0	0.40
SLAP lesions	19.4	81.2	1.03	0.0	84.6	0.00	48.5	41.3	0.83
Biceps disease	50.0	81.3	2.68	28.0	89.0	2.61	83.3	41.7	1.43
AC joint arthritis	24.0	81.6	1.30	5.3	84.4	0.34	47.0	45.0	0.85

*Because the data in some cells represent subgroups of patients, not all denominators equal 1913 patients; S = sensitivity; Sp = specificity; LR = likelihood ratio; SLAP = superior labrum anterior and posterior; and AC = acromioclavicular.

partial tears of the subscapularis tendon[38,39], these findings have not been replicated by independent observers.

Acromioclavicular Joint Abnormalities

Physical examination can help the clinician accurately diagnose abnormalities of the acromioclavicular joint. It is well known that degenerative changes of the acromioclavicular joint are extremely common in patients who are older than thirty years[40]. Therefore, the acromioclavicular joint should not be presumed to be the source of pain in the shoulder unless it can be confirmed on physical examination. Local tenderness is considered by most physicians to be the *sine qua non* for making the diagnosis of acromioclavicular joint disorders. In most patients, pain relief resulting from an injection of local anesthetic into the joint can confirm that the acromioclavicular joint is the cause of the symptoms.

Although the classic cross-body adduction test[24] is helpful diagnostically, the acromioclavicular resisted extension test[2,41] and the active compression test[2] are more specific (but not more sensitive) for the presence of acromioclavicular abnormalities. The use of another test, the Paxinos test[42,43], has not been verified by independent observers.

Shoulder Instability

Anterior Instability

Studies[44,45] have shown that physical examination for anterior shoulder instability is clinically helpful if the criterion for a positive test is the reproduction of a symptom of instability. Specificity of the anterior apprehension test, the relocation test, and the surprise test exceeds 95%[44,46,47]. Apprehension during an anterior apprehension test is associated with a likelihood ratio of 18, and relief of apprehension during a relocation test is associated with a likelihood ratio of 10.

Except with regard to the relocation test, the sensitivity of these tests is low because many patients with traumatic shoulder instability do not have apprehension during these tests. However, if pain is used as a criterion for a positive test, then these tests are generally neither sensitive nor specific.

Studies of shoulder laxity testing and its role in determining the presence of instability[22,45] have identified shoulder laxity as a normal measurement of joint mobility; laxity is considered pathologic only if it reproduces symptoms of instability.

Posterior Instability

To our knowledge, there have only been a few studies[22,48] of the accuracy of physical examination in the diagnosis of posterior instability. If a patient can create the subluxation(called "demonstrable," "voluntary," "muscular," or "habitual") and it is symptomatic, the diagnosis is not in question. However, other variations of posterior instability are not easy to detect with physical examination. It has been suggested that the posterior apprehension sign is a helpful test[49], but, with use of high-speed photography, we have found that it is biomechanically incorrect[50,51]. The jerk test has also been suggested as an accurate method of testing for posterior instability[52-54], but this finding has not been replicated by independent observers.

One study describing the use of posterior laxity testing to diagnose posterior instability has indicated a difference between normal shoulder laxity and instability[22]. Instability is laxity that is excessive enough to produce the symptoms of

TABLE V Physical Examination Signs and Tests for the Shoulder from Our Database (Part E)*

	Cross-Body Adduction Test			Acromioclavicular Resisted Extension Test			External Rotation Lag Sign			Whipple Test		
Diagnosis	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR	S (%)	Sp (%)	LR
Rotator cuff	22.3	75.0	0.89	17.7	80.2	0.89	7.3	84.1	0.46	79.9	32.5	1.18
Tendinosis/bursitis	25.4	79.7	1.25	20.3	81.3	1.08	0.0	87.6	0.00	72.7	23.9	0.96
Partial-thickness tear	16.7	78.5	0.78	22.5	81.6	1.22	3.6	87.3	0.28	71.0	23.4	0.93
Full-thickness tear	23.4	80.8	1.22	17.6	80.9	0.92	3.1	85.0	0.20	81.4	27.0	1.11
Massive tear	12.2	75.7	0.50	11.0	80.8	0.57	35.0	89.1	3.21	100.0	25.9	1.35
Glenohumeral arthritis	21.9	75.8	0.90	13.0	79.7	0.64	14.2	88.9	1.28	87.5	24.9	1.17
Adhesive capsulitis	11.9	76.0	0.50	10.3	81.0	0.55	12.5	87.9	1.03	71.4	24.0	0.94
Glenohumeral instability	11.0	73.1	0.41	9.0	78.8	0.42	7.5	87.4	0.60	48.7	19.0	0.60
Anterior	10.4	74.1	0.40	7.5	79.4	0.37	3.8	87.3	0.30	46.2	20.6	0.58
Posterior	12.1	76.0	0.51	13.3	81.1	0.71	12.5	87.9	1.03	57.1	23.6	0.75
Multidirectional	11.5	76.1	0.48	15.0	81.2	0.80	0.0	87.8	0.00	33.3	23.6	0.44
SLAP lesions	28.6	76.4	1.21	18.8	81.2	1.00	0.0	87.6	0.00	75.0	24.1	0.99
Biceps disease	0.0	76.2	0.00	0.0	81.1	0.00	20.0	88.0	1.67	80.0	24.2	1.06
AC joint arthritis	77.0	79.0	3.67	72.0	85.0	4.80	5.3	87.6	0.42	88.2	25.0	1.18

*Because the data in some cells represent subgroups of patients, not all denominators equal 1913 patients; S = sensitivity; Sp = specificity; LR = likelihood ratio; SLAP = superior labrum anterior and posterior; and AC = acromioclavicular.

subluxation or dislocation. The ability to subluxate the shoulder over the posterior rim of the glenoid is very common, even in asymptomatic shoulders, so for a posterior drawer test to be helpful in diagnosing instability, it should reproduce the symptoms of instability in the patient. To our knowledge, only one study[50] has evaluated the posterior drawer test as a diagnostic test for posterior instability.

Multidirectional Instability

To our knowledge, no study has evaluated the accuracy, validity, or clinical usefulness of current tests for diagnosing multidirectional instability. Multidirectional instability of the shoulder has been traditionally defined[55] as symptomatic instability in two or more directions (anterior, posterior, or inferior). The criterion for inferior instability has been the sulcus sign, which is typically graded as I (<1.0 cm), II (1.0 cm to 2.0 cm), or III (more than 2.0 cm)[3,56-58].

This scheme for describing the severity of inferior shoulder laxity presents several difficulties: (1) to our knowledge, the distance of translation between the humeral head and the glenoid with an inferiorly directed force has not been validated for the different degrees of translation; (2) high grades of inferior laxity are common in asymptomatic individuals, especially in young patients; (3) laxity alone does not necessarily indicate instability; and (4) pain is generally not a reliable criterion for the diagnosis of instability. Although apprehension or subluxation of the humeral head over the glenoid rim is a better measure of instability, these latter criteria are not commonly found during sulcus testing of the shoulder. The role of inferior laxity in recurrent shoulder instability remains controversial. It has been suggested that loose-jointed individuals (asymptomatic with a grade-II or grade-III sulcus sign) with instability in a second direction should be diagnosed as having physiologic hyperlaxity with anterior or posterior instability[59,60].

To our knowledge, no studies have evaluated the clinical examination of patients with multidirectional instability, perhaps because there is no gold standard. However, one study has evaluated the effect of mistaking laxity for instability when making the diagnosis of multidirectional instability[3]. That study showed that if asymptomatic laxity in any direction is used as a criterion for multidirectional instability, it can substantially change the numbers of patients who are given that diagnosis[3].

Anterior and Posterior Lesions of the Superior Labrum

The diagnosis of anterior and posterior lesions of the superior labrum on the basis of physical examination alone remains elusive. There are several physical examination tests for these lesions, but reports have shown variable clinical usefulness and accuracy[5,61,62]. In addition, studies of such tests differ in terms of patient population, method of lesion documentation (magnetic resonance imaging or arthroscopy), type of examiner (independent or the center where the examination originated [the person or group that describes a test typically has better results than others]), and use of a control group.

The choice of the best diagnostic modality continues to be controversial: some authors are proponents of the use of multiple tests[61,63] while others prefer the use of shoulder arthroscopy[64]. At least one study has shown poor interobserver and intraobserver agreement between surgeons who were asked to view videotapes showing anterior and posterior lesions of the superior labrum[65]. Therefore, there is as yet no one universally accepted modality for making the diagnosis.

Biceps Tendon Tears (Other than Anterior and Posterior Lesions of the Superior Labrum)

Biceps tendon abnormalities other than anterior and posterior lesions of the superior labrum include biceps tenosynovitis, partial biceps tendon tears, biceps tendon subluxations, and biceps entrapment in the joint[64,66]. Diagnosing any of these lesions with use of physical examination is difficult because an isolated biceps tendon abnormality is relatively rare[67]. A partial tear of the biceps tendon, subluxation of the biceps tendon, or biceps tenosynovitis often coexists with rotator cuff tears or other intra-articular abnormalities. Therefore, pain in the anterior or lateral aspect of the shoulder during testing of the biceps tendon cannot be reliably ascribed to the biceps tendon alone.

Existing tests and examination techniques for such lesions are not reliable. For example, the Speed test is neither sensitive nor specific for biceps tendon abnormality[67] and palpation of the biceps tendon is not clinically diagnostic because of the close proximity of the insertions of the supraspinatus and the subscapularis tendon. A lift-off test that elicits pain in the anterior aspect of the shoulder may be diagnostic (likelihood ratio, 2.6)[67], but this determination requires additional study.

The Future

In the future, there needs to be more sophisticated studies that integrate history, physical examination, and imaging so that the clinician can more accurately diagnose shoulder lesions. For instance, although the clinician should still examine a patient who presents with a history of anterior shoulder dislocation and a radiograph proving that diagnosis, the results of the apprehension test are obviously less critical when radiographs prove the diagnosis. However, for other entities for which the diagnosis is difficult to make on the basis of history, examination, and imaging (e.g., anterior and posterior lesions of the superior labrum, biceps tendon lesions, and isolated chondral lesions), this type of statistical analysis would prove helpful in diagnosing and guiding treatment. In the future, it may be possible to enter the results of patient history, physical examination, and imaging into a computer and have the most likely diagnosis be calculated statistically.

The other major advance may be the ability to determine the relationship of physical examination to the success of nonoperative or surgical treatment. This capability would allow the clinician to determine if certain physical findings or factors from the patient's history preclude certain types of treatment but relatively guarantee the success of others.

Conclusions

This summary of the literature is reflective of the complexity of shoulder conditions and their presentation in patients and shows that the results of examination are variable and that statistical analysis may not be a substantial improvement on the original observations of Codman[1]. In this study, we created a revised version of his table for the purpose of showing the utility of statistical analysis in evaluating his original observations (Tables I through V). Our tables differ from the original (Fig. 1) in that Codman included more subjective information as well as more conditions that may affect the shoulder but that are not intrinsic just to the shoulder (e.g., cervical radiculopathy). To recreate his table in its entirety, additional study would be necessary to include the wide spectrum of diseases that can affect the upper extremity and shoulder. The shoulder continues to be a challenge for clinicians because of this inexactitude, but advances in biology, biomechanics, pathologic abnormalities, and clinical medicine will continue to unravel the mysteries of the shoulder complex and the conditions that affect it.

Appendix

*e*A Seven summary tables presenting the sensitivity, specificity, and predictive values of specific diagnostic tests for each disease category derived from the literature are available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD/DVD (call our subscription department, at 781-449-9780, to order the CD or DVD). ■

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