EDITOR'S CHOICE

A new classification system for shoulder instability

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ABSTRACT

Glenohumeral joint instability is extremely common yet the definition and classification of instability remains unclear. In order to find the best ways to treat instability, the condition must be clearly defined and classified. This is particularly important so that treatment studies can be compared or combined, which can only be done if the patient population under study is the same. The purpose of this paper was to review the problems with historical methods of defining and classifying instability and to introduce the FEDS system of classifying instability, which was developed to have content validity and found to have high interobserver and intraobserver agreement.

Glenohumeral joint instability is extremely common. With regard to primary anterior shoulder dislocations, the incidence is between 8.2 and 23.9 per 100 000 person-years, with an estimated prevalence of 1.7%.[1–3] Whereas these estimates seem high, they actually underestimate the true nature of instability, as they do not include subluxation events or instability in other directions. Despite the widespread nature of glenohumeral joint instability, the definition of this condition is not clear and there is no consensus on how this disorder should be classified.

Historically, the medical literature regarding instability has a number of flaws. First, most studies in the literature are procedure-based and not condition-based. An example is the landmark 1980 paper by Neer and Foster[4] on 'multidirectional' instability. In that study, the authors included patients with different features of instability—yet the patients had in common the same operation, an inferior capsular shift (table 1). When a paper is procedure based it may include a heterogenic population that will produce confusion both regarding the definition of the condition and whether the procedure described would be helpful for a particular patient in your office. Instead, papers should be condition-based, in which a population of patients with a specific, well-defined constellation of features is collected and two treatments are compared.

As a result of these historical problems, we do not have clear definitions for glenohumeral joint instability in the literature and papers tend to use a pot-pouri of descriptive terms (voluntary, traumatic unidirectional Bankart lesion treated with surgery, unidirectional, multidirectional, bidirectional, traumatic, atraumatic, microtraumatic, etc). This problem leads to heterogeneity in the literature making comparisons of different treatments difficult and meta-analyses nearly impossible.

This confusion has been highlighted by McFarland *et al*,[5] who compared four different classification systems for patients with instability and found great variation, particularly with regard to multidirectional instability, leading the editors of the *Journal of Bone and Joint Surgery* to opine that the article by McFarland *et al*[5] was a "…provocative call to action", and "Until the criteria for diagnosis are clearly defined, investigators will be unable to contribute in a compelling way to understand the condition since they cannot know whether studies are comparing 'apples and oranges'."[6] This confusion in how instability is defined was also demonstrated by Chahal *et al*,[7] who found that physicians had poor agreement when asked to classify clinical scenarios of glenohumeral joint instability. These works provide evidence that we need better ways of defining and classifying glenohumeral joint instability.

Table 1 Features of Neer and Foster's multidirectional instability population

Feature	No with symptom (N=40) for entire population
Solitary episode	0
More than one episode	40
Traumatic origin	29
Atraumatic origin	7
Direction anterior	29
Direction inferior	40
Direction posterior	29
Subluxation event	38
Dislocation event	2
Hyperlaxity	17
Presence of Bankart lesion	5

The frequency with which different features of instability are found in Neer and Foster's classic 1980 paper on multidirectional instability—all had in common the same inferior capsular shift operation.

DEFINITIONS OF INSTABILITY

Before a disorder is classified, it must be defined very clearly. For example, does a pitcher with a dead-arm feeling when throwing have 'instability'? Does a patient with a posterior labral tear with pain, but not sensation of the joint slipping or a feeling of looseness—have 'instability'? Historically, many experts have offered different definitions for this common malady. In 1992, many of the North American shoulder experts met in Vail, Colorado, to help define and determine the state of the art for many shoulder conditions.[8] Interestingly, these experts offered a variety of definitions for glenohumeral joint instability (figure 1). In light of these different perspectives, how can a consensus be reached? The two common themes in these definitions are symptoms and translation. We know that many patients may have symptoms (especially pain) without instability. We also know that laxity exists in many

"…the inability to maintain the humeral head centered in the glenoid fossa" *Overview and Directions of Future Research. The Shoulder: a Balance of Mobility and Stability, Matsen FA, Fu FH, Hawkins RJ eds, AAOS, Rosemont, Illinios, 1993, p. 3.*

"Instability is an abnormal limit of motion associated with a functional deficit (dynamic instability) or subluxation/dislocation (static or dynamic instability). A dynamically unstable configuration of load state would be one in which an increment of load will cause pain and inability to continue the function; in other words, "functionally buckling". A statically unstable configuration and load state would be the one in which an incremental increase in load leads to a large displacement with subsequent subluxation or dislocation." *Lew WD, Lewis JL, Craig EV. Stabilization by Capsule, Ligaments, and Labrum: Stability at the Extremes of Motion. The Shoulder: a Balance of Mobility and Stability, Matsen FA, Fu FH, Hawkins RJ eds, AAOS, Rosemont, Illinios, 1993, p. 84.*

"Glenohumeral instability can be defined as pain associated with the loss of shoulder function as a result of excessive translation of the humeral head on the glenoid fossa" *Friedman RJ. Glenohumeral Capsulorraphy. The Shoulder: a Balance of Mobility and Stability, Matsen FA, Fu FH, Hawkins RJ eds, AAOS, Rosemont, Illinios, 1993, p. 446.*

"This is a condition of a joint characterized by an abnormal increased amount of mobility secondary to injury of the ligaments, capsule, bone etc; when applied to the shoulder, instability typically is used to describe a clinical condition characterized by physical signs and related patients symptoms of increased or excessive displacement of the glenohumeral joint." *Rodkey WG, Noble JS, Hintermeister RA. Laboratatory Methods of Evaluating the Shoulder. The Shoulder: a Balance of Mobility and Stability, Matsen FA, Fu FH, Hawkins RJ eds, AAOS, Rosemont, Illinios, 1993, p.570*

"Instability is a clinical diagnosis manifest as excessive translation of the humeral head on the glenoid occurring during active shoulder rotation in association with symptoms" *Warner JJP, Boardman ND III. Anatomy, Biomechanics, and Pathophysiology of Glenohumeral Instability. In The Unstable Shoulder. RF Warren, EV Craig, and DW Altchek eds, Lippencott-Raven, Philadelphia, 1999, p 51-2.*

"Instability is defined as excessive symptomatic translation of the humeral head relative to the glenoid articular surface during active motion" *Allen AA. Clinical Evaluation of the Unstable Shoulder. In The Unstable Shoulder. RF Warren, EV Craig, and DW Altchek eds, Lippencott-Raven, Philadelphia, 1999, p 93.*

Figure 1 Variation in how experts define glenohumeral joint instability.

patients without symptoms, and that some patients can sublux their shoulders without symptoms. Therefore, these two elements must be found together to define instability—patients must have discomfort and a feeling of looseness, slipping, or the shoulder 'going out' to meet the definition of instability.

CLASSIFICATION OF INSTABILITY

Once the condition is clearly defined, its features can be studied and categorised into meaningful classification systems. The classification of instability would help us in many ways. Instability classification systems should alert us to specific anatomical features we can expect to see with a specific type of instability, they should give us information regarding the natural history and prognosis of a type of instability, and they ultimately should offer recommendations regarding treatment.

A variety of classification systems have been proposed for shoulder instability.[9–25] The authors of these papers developed their instability classification system after careful thought, yet the variation is remarkable. Although there is some agreement regarding the features that are included (figure 2), there is also a great amount of discordance, and different features are included in different classification systems. Interestingly, none of these systems has undergone reliability testing or validation. It is not surprising that there is no standard method to classify instability and that studies have demonstrated that patients may be given different diagnoses when different methods of classifying instability are used,[5] and that physicians have poor agreement in how they describe the same patient.[7]

THE FEDS SYSTEM FOR CLASSIFYING GLENOHUMERAL JOINT INSTABILITY

At our institution we undertook a systematic approach to develop a method to classify shoulder instability—the FEDS classification.[26] We performed a systematic review of the literature to identify proposed classification systems, and determined which features of instability were used most commonly (figure 2). Of all of the features of instability used by the

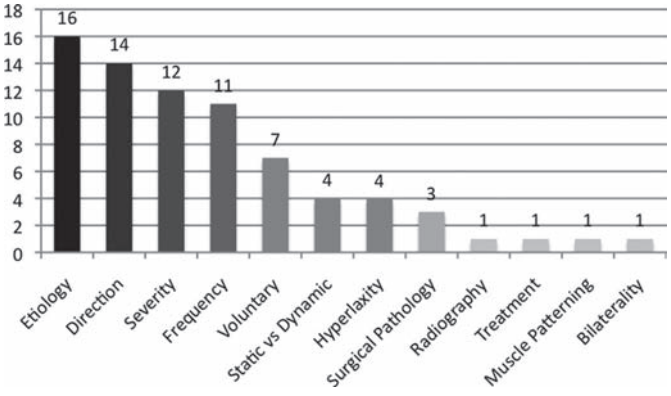

Figure 2 Different criteria used by different authors in proposed classification systems of glenohumeral joint instability. A systematic review identified 18 different proposed classification systems of glenohumeral instability. The frequency with which different features are used is presented. Aetiology, direction, severity and frequency were the most commonly used features (from Allen,[9] Cole and Warner,[10] Cofield and Irving,[11] Galinat and Warren 1990,[12] Gerber and Nyffeler,[13] Joseph *et al*,[14] Lewis *et al*,[15] Maruyama *et al*,[16] Nebelung,[17] Ozkan *et al*,[18] Pollock and Flatow,[19] Protzman,[20] Rockwood,[21] Schneeberger and Gerber,[22] Silliman and Hawkins,[23] Thomas and Matsen,[24] Wirth and Rockwood[25]).

authors, four were seen in more than 50% of the proposed classification systems: frequency, aetiology, direction and severity. Interestingly, these features were reflected in the results of a survey of the membership of the American Shoulder and Elbow Surgeons. Features rated as extremely important in making the diagnosis of instability included: (1) the patient's history and physical examination in the office; (2) a history of trauma; (3) patients demonstrating the position of the arm that reproduces symptoms; (4) reproduction of symptoms using provocative testing and (5) determining the direction of the instability by physical examination. Interestingly the radiographic features and examination under anaesthesia were not rated as extremely important.

This information then led to the development of the FEDS classification for instability. Fortunately, the features of instability deemed most important (frequency, aetiology, direction and severity) could be obtained by history and physical examination. After a meeting of experts, the FEDS system was developed (figure 3).

Frequency

Frequency is an indirect measure of the severity of pathology, and is helpful in determining the approach to the patient. We purposefully chose the number of episodes over the course of 1 year due to the seasonal nature of sports. In considering frequency, the FEDS system has three levels. Solitary = one episode. It is likely that many patients with one episode will be managed non-operatively. Occasional = two to five episodes. The patient with a few episodes may have a very different type of instability to the patient with more than five episodes per year, which would be described as frequent.

Aetiology

Most classification systems consider aetiology to be important and argue that patients with a history of trauma are managed differently to those without. While repetitive loading leading to symptoms has been described in the past as 'microtraumatic' or 'subtle' instability, we purposefully chose not to include this as a separate class (see below). Most athletes with shoulder trouble do not have instability by the definition above (a feeling that the shoulder is slipping, loose or going out)—rather they present with pain. As such, they would not be defined as having glenohumeral instability. Some athletes could have a feeling that their shoulder is loose without a specific injury. This group would fall under the atraumatic group.

Direction

Nearly every classification system includes the direction of the instability. In the FEDS classification, we rely on the history and the patient's perception of the instability. Patients may be able to tell you the direction of their instability, or may be able to tell you which position of the arm will reproduce their symptoms (hand behind the head for anterior, carrying a briefcase for inferior, pushing on something in front of the body for posterior). If the patient cannot tell the physician, the effect of provocative tests (translation anterior, inferior, posterior or apprehension test, sulcus sign, jerk test) will help determine the direction. We purposefully decided to eliminate the concept of 'multidirectional instability', and instead focused on the primary direction of symptoms when describing the direction of the instability (see below).

Severity

The severity of the instability is another criterion that comes from the history and is another indirect measure of the severity of the pathology. Patients can have subluxations or dislocations. It may be difficult to distinguish between these; however, in general subluxations will autoreduce, whereas dislocations will not. Therefore, the question for the patient: "Did you need, or have you ever needed help getting your shoulder back in?" is a yes or no question. It serves as a differentiating point, for the severity of the injury may help us gain some insight into the pathology.

TESTING OF THE FEDS SYSTEM

The FEDS classification system was assessed for interobserver and intraobserver agreement in a population of 48 patients with instability defined by answering yes to the question: "Do you feel like your shoulder is slipping, unstable, loose, or falling out of place?" These patients completed a survey, as did one of six sports medicine fellowship trained specialists. Patients returned after a minimum of 2 weeks and completed the survey again, as did the original treating physician and a second physician. Intraobserver agreement for the FEDS system was 84–97% with k ranging from 0.69 (substantial) to 0.87 (almost perfect). Interobserver agreement was 82–90%, with k ranging from 0.44 (moderate) to 0.76 (substantial).[26]

DISCUSSION

The FEDS classification system is highly dependent upon the history and therefore the patient's perception of the disorder. Of all of the possible criteria for classifying instability, frequency, aetiology, severity and even direction can be obtained by questioning patients. Other criteria used historically to classify glenohumeral joint instability are physician derived, and include findings of examination under anaesthesia, examination and physician judgement as to the presence of a volitional nature to the instability, examination and physician judgement as to the presence of hyperlaxity, radiographic findings and pathological findings from surgery.

FREQUENCY–The patient is asked, ***"How many episodes have you had in the last year?"***

Solitary – ***'1 Episode'***
Occasional- ***'2 -5 Episodes'***
Frequent – ***'>5 Episodes'***

ETIOLOGY – The patient is asked, ***'Did you have an injury to cause this?'***

Traumatic – ***' Yes'***
Atraumatic – ***' No'***

DIRECTION – The patient is asked, ***' What direction does the shoulder go out most of the time?'***

Anterior- ***'Out the Front'***
Inferior- ***' Out the Bottom'***
Posterior- ***'Out the Back'***

The direction is confirmed at the time of the physical examination using provocative tests. During translation testing, the physician asks, which one of the following directions most closely reproduces your symptoms, and then translates anterior, inferior, and posterior. To confirm, the physician may ask which one of these tests most closely reproduces your symptoms: and the anterior apprehension test, the sulcus test, and the posterior jerk test is performed. With the history and physical examination using provocative tests, the patient should be able to distinguish and identify the ***primary direction*** of his or her instability.

SEVERITY–The patient is asked,***'Have you ever needed help getting the shoulder back in joint?'***

Subluxation– ***'No'***
Dislocation – ***'Yes'***

Figure 3 The FEDS classification for instability.

In general, physician-derived criteria are less valuable, as the findings during examination are highly dependent upon the skill and experience of the examiner. As such, examination findings are highly subjective and interrater/intrarater reliability is poor.[27–29] In addition, radiographic findings are dependent upon the presence of imaging tools, which may not be available in some parts of the world, and are likely to change as technology improves with time. Using pathological findings from surgery as a criterion is not ideal as it precludes making a diagnosis until surgery is performed. This would prevent the assignment of patients into groups for trials of non-operative therapy.

Interestingly, provocative physical examination tests designed to reproduce the patient's symptoms for instability, including the anterior apprehension test, the sulcus sign and load and shift tests, have been found to be sensitive, specific, and have high predictive values, with reasonable interexaminer reliability.[30–33] Therefore, these features of the evaluation of the patient with instability can be useful. In the FEDS system, they are used in a comparative fashion to identify the primary direction of instability by finding which provocative test is most uncomfortable, or most closely reproduces the patient's symptoms.

The problem with 'multidirectional' instability

With regard to the direction of the instability, we intentionally focused on determining the primary direction of the instability and did not use the 'multidirectional' concept. We did this for the following reasons: (1) The term 'multidirectional instability' has been used by different authors to mean different things,[5] and as a result the literature is very confusing.[6 14 34] (2) Neer and Foster[4] in 1980 originally described the condition of multidirectional instability as having the sine qua non-feature of an increased sulcus sign, which would equate to having primary inferior symptoms in the proposed classification. (3) It could be argued that every form of shoulder instability could have excessive translations in multiple planes, as biomechanical and clinical research suggests that the capsule of the glenohumeral joint behaves as a circle and that injuries are unlikely to produce damage in only one part of the capsule.[35–39] As a result, the concept of 'multidirectional' instability is flawed and it is unlikely to have a clear agreed-upon definition among clinicians—as such we argue for its elimination, substituting the primary direction to describe the direction of instability instead.

The problem with 'subtle instability'

Rowe[40] described the 'dead arm' syndrome in 1987. While some patients described a sense of shoulder looseness, many did not. Rowe considered all to have instability and performed instability surgery as a treatment. The problem is, as Rowe noted, pain is not specific for instability. Many of Rowe's patients had "signs and symptoms of bursitis, biceps tendonitis, nerve impingement, cervical spine referred pain and thoracic outlet syndrome."[40] As such, it is not clear if these patients truly had instability.

Jobe *et al*[41] in 1989 used 'subtle instability' to describe the athlete with shoulder pain. In this condition the patient may not have symptoms of the shoulder subluxing or dislocating, yet excessive laxity in the capsule presumably leads to other

pathologies and other symptoms such as pain. Jobe used an instability operation to treat these patients and reported good success.

We would argue that the term 'subtle instability' is a poor choice, and that perhaps 'excessive laxity' would have been better. Again we refer to the concept that symptoms of instability are required for the diagnosis of instability. As such, patients with the constellation of findings that are seen in the athlete with the painful shoulder do not belong in the diagnosis of instability unless the athlete has symptoms of the arm having episodes of being loose. We would argue that as our understanding of the pathomechanics of the thrower's shoulder develops, a unique system for classifying different grades of pathology in the painful shoulder of the athlete will evolve.

The problems with 'voluntary' instability

In 1973, Rowe *et al*[42] published a series of patients with 'voluntary instability'. After performing psychological testing on these patients, Rowe brought attention to the fact that patients with secondary gain age or psychiatric pathology did poorly with treatment. Those with voluntary instability who tested normally on psychological testing did well with treatment.[42] It would seem that there are two types of voluntary instability that can be distinguished by psychological testing. However, because physicians do not perform psychological testing on their patients, this concept has led to a great amount of confusion in the literature. A number of other descriptors for this condition exist in the literature, including 'habitual instability'[43] (which has erroneously included voluntary and involuntary by some authors)[44] and 'involuntary positional instability'.[45] These definitions are confused in the literature and it is difficult to distinguish which patients may have psychological issues.[15] As a result, we do not believe the term 'voluntary instability' is particularly helpful in a classification of glenohumeral instability. Instead, we would consider using this concept as a qualifier for the descriptions above, and change the terminology to 'demonstrable instability' to describe patients who can demonstrate their instability but have no psychological or secondary gain issues, and 'volitional instability' for those patients who have the desire for their shoulder to sublux or dislocate. We would also recommend that researchers consider psychological testing on these patients to validate their classification of patients when studying such patients.

CONCLUSION

Any classification system must meet the following criteria: (1) it must be simple and easy to use; (2) it must accurately describe different types of instability with exclusion so that there is no ambiguity with assignment of patients; (3) it must have high reliability; (4) it should reflect the patient's perception of the disorder so that the integrity of outcome measures can be preserved; (5) it should be useful in predicting the natural history and possible treatment options.

It is clear that current methods of classifying glenohumeral joint instability have led to much confusion in the literature and do not meet these criteria. We suggest that a standard definition of instability should be used, and should include symptoms of the shoulder slipping, falling out, subluxing or dislocating. Using this definition, patients who are diagnosed as having glenohumeral joint instability should be classified using a system that is clear and contains the important features of the disorder. We propose that clinicians and researchers or investigators consider using the FEDS system, which by its development has content validity and has been shown to have high intraobserver and interobserver agreement. Once patients are clearly classified, only then can comparative studies of treatments be undertaken.

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