J Shoulder Elbow Surg (2019) 28, 95–101

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Epidemiology of the Frequency, Etiology, Direction, and Severity (FEDS) system for classifying glenohumeral instability

Carolyn M. Hettrich, MD, MPH[a], Kevin J. Cronin, MD[a,*], Martin B. Raynor, MD[b], Emily Wagstrom, MD[c], Sunil S. Jani, MD[d], James L. Carey, MD, MPH[e], Charles L. Cox, MD, MPH[f], Brian R. Wolf, MD, MS[g], John E. Kuhn, MD[f]

[a]*Department of Orthopaedic Surgery & Sports Medicine, University of Kentucky, Lexington, KY, USA*
[b]*Texas Orthopaedic Associates, Dallas, TX, USA*
[c]*Hennepin Healthcare, Minneapolis, MN, USA*
[d]*Department of Orthopaedics & Sports Medicine, University of Cincinnati, Cincinnati, OH, USA*
[e]*Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA, USA*
[f]*Vanderbilt Sports Medicine, Nashville, TN, USA*
[g]*Department of Orthopaedics, University of Iowa, Iowa City, IA, USA*

Hypothesis: The purpose of this multicenter epidemiologic study was to determine the distribution of patients within the Frequency, Etiology, Direction, and Severity (FEDS) classification system to determine which categories are of clinical importance.

Methods: Shoulder instability patients were identified using *International Classification of Diseases, Ninth Revision* coding data from 3 separate institutions from 2005-2010. Data were collected retrospectively. Details of instability were recorded in accordance with the FEDS classification system. Each patient was assigned a classification within the FEDS system. After all patients were assigned to a group, each group was individually analyzed and compared with the other groups.

Results: There are a total of 36 possible combinations within the FEDS system. Only 16 categories were represented by at least 1% of our patient population. Six categories captured at least 5% of all patients with shoulder instability. Only 2 categories represented greater than 10% of the population: solitary, traumatic, anterior dislocation, with 95 patients (24.8%), and occasional, traumatic, anterior dislocation, with 63 patients (16.4%).

Conclusions: There are 16 categories within the FEDS classification that are clinically significant. Solitary, traumatic, anterior dislocation and occasional, traumatic, anterior dislocation were the most frequently observed in our cohort.

Level of evidence: Descriptive Epidemiologic Study

Keywords: Shoulder; instability; classification; multidirectional instability; dislocation; subluxation

Institutional review board approval was received (University of Iowa, No. 201111745).

*Reprint requests: Kevin J. Cronin, MD, Orthopaedic Surgery & Sports Medicine, University of Kentucky, 740 S Limestone, K403, Lexington, KY 40536, USA.

E-mail address: kevincronin88@gmail.com (K.J. Cronin).

1058-2746/$ - see front matter
https://doi.org/10.1016/j.jse.2018.08.014

Shoulder instability is a relatively common problem in the general population. The most common direction of instability is anterior, with recent epidemiologic studies estimating the prevalence of primary anterior shoulder dislocation in the general population to be as high as 1.7%.[8,21,31] Anterior dislocations are 15.5 to 21.7 times more common than posterior dislocations, which occur at a rate of 1.1 per 100,000 population per year.[26,27] This is an underestimation of all shoulder instability because it does not include subluxation or subtle instability, as well as inferior instability. Numerous authors have devised classifications for shoulder instability; however, these are often not complete, and there is not consistent use in the literature. Without a clear and comprehensive classification system that is used consistently in research publications, it will be difficult to determine the prevalence of shoulder subluxation, as well as dislocation, or to draw conclusions on the diagnosis and treatment of shoulder instability.

Given these inherent difficulties, a new classification for shoulder instability was recently developed. The main goal of the Frequency, Etiology, Direction, and Severity (FEDS) classification system is to provide a simple and reproducible method to define shoulder instability in all patients.[11,12] The FEDS system applies 4 essential characteristics of most shoulder instability classifications: frequency, etiology, direction, and severity. Frequency is subclassified as solitary (1 instability episode), occasional (2-5 episodes), or frequent (>5 episodes), all within the past year. The etiology of the original instability event is either traumatic or atraumatic. Direction refers to the patient's primary direction of instability—anterior, posterior, or inferior. If the patient is unsure regarding the primary direction, a physical examination can be used to supplement his or her history. The final component is severity, which can be either a subluxation or a true dislocation. True dislocation events are those that required the assistance of another individual for reduction. Any other instability events were classified as subluxations.

A useful classification system is easy to apply and should provide information regarding the natural history, prognosis, and treatment strategies. The FEDS classification can be applied using 4 simple questions from the patient's history. The FEDS system has also previously been shown to predict the need for surgical intervention.[13] Both the interobserver agreement and intraobserver agreement were previously reported and shown to be excellent.[12] The purpose of this multicenter epidemiologic study was to determine the distribution of patients in each FEDS category to determine which categories are of clinical importance.

Materials and methods

A retrospective patient database was created consisting of all patients with a diagnosis of shoulder instability at 3 separate institutions from 2005 to 2010. Shoulder instability patients were identified using the *International Classification of Diseases, Ninth Revision* coding data shown in Table I. The database included all patients across the institutions, not just within the orthopedic departments. Patient demographic characteristics, details of instability, and information about imaging and treatment were entered into REDCap (Research Electronic Data Capture; Vanderbilt University, Nashville, TN, USA) after a thorough chart review. Recorded demographic characteristics included age at initial presentation, age at initial instability episode, sex, hand dominance, and presence or absence of ligamentous laxity. Details of instability were recorded in accordance with the FEDS classification system, which has been previously described.[11,12] The FEDS classification system includes frequency of instability in 1 year (solitary [1 episode], occasional [2-5 episodes], or frequent [>5 episodes]), etiology of initial episode (traumatic or atraumatic), primary direction of instability (anterior, posterior, or inferior), and severity of instability event (whether the patient required assistance to reduce the shoulder).

Table I ICD-9 coding data used to identify patients with glenohumeral instability

Code	Description
718.21	Pathologic dislocation of shoulder
718.31	Recurrent dislocation of shoulder
718.71	Developmental dislocation of shoulder
718.81	Joint derangement NEC shoulder
718.91	Joint derangement NOS shoulder
719.81	Other specified disorders of joint, shoulder region
831.00	Closed dislocation of shoulder, unspecified
831.01	Closed anterior dislocation of humerus
831.02	Closed posterior dislocation of humerus
831.10	Open dislocation of humerus NOS
831.11	Open anterior dislocation of humerus
831.12	Open posterior dislocation of humerus
831.13	Open inferior dislocation of humerus
831.19	Open dislocation of humerus, other
840.07	Superior glenoid labrum lesion

ICD-9, *International Classification of Diseases, Ninth Revision*; *NOS*, not otherwise specified; *NEC*, not elsewhere classified.

By use of the REDCap database, each patient was assigned a classification within the FEDS system. With 4 discrete variables (frequency, etiology, direction, and severity), there are a total of 36 possible groups to which patients may be assigned. After all patients were assigned to a group, each group was individually analyzed and compared with the other groups. Categorical variables were analyzed with frequencies and percentages, whereas continuous variables were defined with means and standard deviations.

Results

By use of *International Classification of Diseases, Ninth Revision* coding data, 1537 patients were identified for review at our 3 institutions from 2005 to 2010. We excluded a total of 894 patients for not having true instability (wrong diagnosis code) and an additional 260 patients for incomplete or missing data points. The remaining 383 patients were fully classified using the FEDS criteria. Each patient was placed into a single category based on chart review. The categorical definitions of the FEDS classification prevent ambiguity in classification. Most patients were male patients (72%), with

Table II Complete patient demographic data for included patients with glenohumeral instability

	Data (n)
Sex	
Female	28.5% (109)
Male	71.5% (274)
Mean age (range), yr	
First episode	28.1 (3-85)
Presentation	30.1 (10-85)
Dominant arm	
Left	13.3% (34)
Right	86.7% (221)
Affected arm	
Left	44.4% (170)
Right	49.9% (191)
Both	5.7% (22)
Injury during sport	
Yes	49.9% (184)
No	50.1% (185)

an average age at initial presentation of 25.6 years (range, 8-85 years). The remaining, female patients (28%) presented at a slightly older average age of 34.3 years (range, 3-85 years). Sport was involved in the instability events 48% of the time (n = 184). Complete demographic information is presented in Table II.

Most patients had a solitary instability event (n = 174, 45.4%), whereas 110 (28.7%) had occasional instability and 99 (25.9%) had frequent episodes of instability. A large majority of instability events were traumatic (n = 330, 86.2%), with very few being atraumatic (n = 53, 13.8%). Anterior instability events were by far the most common (n = 312, 81.5%), followed by posterior (n = 63, 16.4%) and inferior (n = 8, 2.1%). Finally, 232 patients (60.6%) had dislocations, whereas 151 patients (39.4%) were defined as having subluxations.

When the FEDS criteria are applied to a cohort of patients, there are a total of 36 possible combinations. Only 16 categories were represented by at least 1% of our patient population. Six categories captured at least 5% of all patients with shoulder instability. The most common category in our data set was solitary, traumatic, anterior dislocation (STAD), with 95 patients (24.8%). The next most common category—and the only other category encompassing greater than 10% of the patient population—was occasional, traumatic, anterior dislocation (OTAD), with 63 patients (16.4%). Table III provides more detailed information.

Four additional groups accounted for greater than 5% of the study cohort: solitary, traumatic, anterior subluxation, with 32 patients (8.4%); frequent, traumatic, anterior subluxation, with 31 patients (8.1%); frequent, traumatic, anterior dislocation, with 29 patients (7.6%); and occasional, traumatic, anterior subluxation, with 26 patients (6.8%). Of the 20 categories with less than 1% of the population, 13 had at least 1 patient and 7 had no patients. Table IV provides a breakdown of each FEDS category.

Of the 312 patients with anterior instability, 88.5% (n = 276) had traumatic instability and the remaining 11.5% (n = 36) had atraumatic instability. Within the cohort of anterior instability patients, 43.9% (n = 137) had a solitary event whereas 30.8% (n = 96) had occasional instability and 25.3% (n = 79) had frequent instability. Anterior instability events were defined as subluxations 34.0% of the time (n = 106) and dislocations 66.0% of the time (n = 206). There was a similar trend in the posterior instability group (n = 63), with 79.4% (n = 50) having traumatic instability and 20.6% (n = 13) having atraumatic instability. Posterior instability patients also had solitary (54.0%, n = 34), occasional (19.0%, n = 12), and frequent (22.2%, n = 14) instability events in a similar distribution. Severity was similar as well, with 63.5% (n = 40) having subluxations and 36.5% (n = 23) having dislocations.

Traumatic, anterior instability accounted for 72.1% of the cohort (n = 276). Overall, trauma accounted for 79.4% of posterior instability and 88.5% of anterior instability. There was a nearly equal breakdown of patients with 1 episode of instability (n = 209, 54.6%) and patients with recurrent events (n = 174, 45.4%). Patients with anterior instability had more than 1 episode of instability 56.1% of the time (n = 175), whereas patients with posterior instability had more than 1 instability event only 46.0% of the time (n = 29).

Discussion

Shoulder instability is a common problem particularly in young, active patients. This can lead to time away from sport or work with the potential for lost income. The lack of a clear and distinct definition of shoulder instability has made studying this clinical entity challenging. We have performed the first study looking at the epidemiology of a group of patients with use of the FEDS classification. Many experts have offered varying classifications of shoulder instability, with the 2 most prevalent components being symptoms and direction of translation of the humeral head within the glenoid.[2,3,5-7,9,10,16,18,24,29,34] Including symptoms and direction of instability is a good start for a reproducible classification system but is not comprehensive. Therefore, we must widen our definition of instability to include other objective factors, such as the frequency and etiology, as well as whether they were subluxation or dislocation events.

Historically, authors have published studies that are procedure based (eg, the inferior capsular shift study by Neer and Foster,[20] in which all patients who underwent the procedure were included). This leads to difficulties because the patient population is heterogeneous and can lead to confusion regarding indications for surgery and defining the diagnosis. Instead, studies should be condition based, identifying a specific population of patients who share important features of the disease and then determining which treatment works best for that specific population. Regarding shoulder instability, the FEDS classification system allows for this approach.

Table III Demographic data for most commonly identified FEDS categories

	Solitary, traumatic, anterior subluxation	Solitary, traumatic, anterior dislocation	Occasional, traumatic, anterior subluxation	Occasional, traumatic, anterior dislocation	Frequent, traumatic, anterior subluxation	Frequent, traumatic, anterior dislocation
Total	8.4 (32)	24.8 (95)	6.8 (26)	16.4 (63)	8.1 (31)	7.6 (29)
Female	21.9 (7)	37.9 (36)	15.3 (4)	27.0 (17)	19.4 (6)	27.6 (8)
Mean age at first event, yr	24.7	40.7	17.9	23.4	19.8	20.2
Surgery	40.6 (13)	36.8 (35)	53.8 (14)	79.4 (50)	80.6 (25)	93.1 (27)
Postoperative recurrence	15.4 (2)	11.4 (4)	14.3 (2)	10.0 (5)	16.0 (4)	33.3 (9)
Sport	56.3 (18)	33.7 (32)	80.8 (21)	63.5 (40)	71.0 (22)	58.6 (17)

FEDS, Frequency, Etiology, Direction, and Severity.
Data are presented as percentage (number) unless otherwise indicated.

Table IV Detailed breakdown of all patients according to assigned FEDS classification

	% (n)
Solitary, traumatic, anterior subluxation	8.4 (32)
Solitary, traumatic, anterior dislocation	24.8 (95)
Solitary, traumatic, inferior subluxation	0.3 (1)
Solitary, traumatic, inferior dislocation	0.5 (2)
Solitary, traumatic, posterior subluxation	3.7 (14)
Solitary, traumatic, posterior dislocation	3.7 (14)
Solitary, atraumatic, anterior subluxation	0.5 (2)
Solitary, atraumatic, anterior dislocation	2.1 (8)
Solitary, atraumatic, inferior subluxation	0 (0)
Solitary, atraumatic, inferior dislocation	0 (0)
Solitary, atraumatic, posterior subluxation	0.3 (1)
Solitary, atraumatic, posterior dislocation	1.3 (5)
Occasional, traumatic, anterior subluxation	6.8 (26)
Occasional, traumatic, anterior dislocation	16.4 (63)
Occasional, traumatic, inferior subluxation	0.3 (1)
Occasional, traumatic, inferior dislocation	0 (0)
Occasional, traumatic, posterior subluxation	2.3 (9)
Occasional, traumatic, posterior dislocation	0.3 (1)
Occasional, atraumatic, anterior subluxation	0.5 (2)
Occasional, atraumatic, anterior dislocation	1.3 (5)
Occasional, atraumatic, inferior subluxation	0.3 (1)
Occasional, atraumatic, inferior dislocation	0 (0)
Occasional, atraumatic, posterior subluxation	0.3 (1)
Occasional, atraumatic, posterior dislocation	0.3 (1)
Frequent, traumatic, anterior subluxation	8.1 (31)
Frequent, traumatic, anterior dislocation	7.6 (29)
Frequent, traumatic, inferior subluxation	0 (0)
Frequent, traumatic, inferior dislocation	0 (0)
Frequent, traumatic, posterior subluxation	2.6 (10)
Frequent, traumatic, posterior dislocation	0.5 (2)
Frequent, atraumatic, anterior subluxation	3.4 (13)
Frequent, atraumatic, anterior dislocation	1.5 (6)
Frequent, atraumatic, inferior subluxation	0.5 (2)
Frequent, atraumatic, inferior dislocation	0.3 (1)
Frequent, atraumatic, posterior subluxation	1.3 (5)
Frequent, atraumatic, posterior dislocation	0 (0)

FEDS, Frequency, Etiology, Direction, and Severity.

The FEDS classification can be entirely derived from the patient's history or chart review, as we were able to do retrospectively in the majority of patients across 3 different institutions (including all departments in the hospital, not just orthopedics). In the assessment of the direction (anterior, posterior, or inferior), physical examination maneuvers can be used to supplement the patient's history. The physician can apply the anterior apprehension test, sulcus test, or posterior jerk test to determine which maneuver most closely reproduces a patient's symptoms. These examination maneuvers have been shown to be sensitive and specific with adequate interexaminer reliability.[15,33] Many historical classifications have relied on physician judgment, examination with the patient under anesthesia, advanced imaging, or arthroscopic findings at the time of surgery. There is inherent difficulty with this method because all patients do not undergo advanced imaging and, certainly, all patients do not undergo surgery. The FEDS classification is simple to apply and reproducible.[12]

As noted previously, many other authors have attempted to classify and define shoulder instability and many elements of these classification systems have merit. Accurate classification has been difficult, and assigning appropriate treatment strategies based on these classifications has been even more elusive. We believe oversimplification of the complex problem of shoulder instability has been the root of many of the problems with previous systems. One of the most popular classification systems is that proposed by Thomas and Matsen.[32] In their original article, they described 2 groups of instability patients: traumatic, unidirectional Bankart lesion and surgery (TUBS) and atraumatic, multidirectional, bilateral, rehabilitation, and inferior capsular shift (AMBRI). The longevity of this classification system likely results from its simplicity and being easy to remember. The authors' original article consisted of a case series of 36 shoulders with traumatic anterior instability and described their open technique for repair of the glenohumeral ligaments. A large majority of patients (97%) had Bankart lesions, leading to the TUBS classification. The authors also described a second

group of patients with bilateral, atraumatic multidirectional instability. These patients with multidirectional instability were thought to benefit most from physical therapy and, only if absolutely necessary, an inferior capsular shift. This classification is fantastic for these groups of patients but does not include posterior instability, unidirectional subluxation, and so on. Within multidirectional instability, there is usually a primary direction of instability.

Rockwood and Matsen[28] described a system similar to the FEDS system, which used etiology and severity but did not include direction. It also distinguished between voluntary and involuntary instability, which can be challenging to determine clinically and necessitates that the clinician have a heightened awareness of possible secondary gain. Type 1 is defined as traumatic subluxation without frank dislocation, whereas type 2 is traumatic with frank dislocation. Type 3 includes atraumatic voluntary subluxation and is broken down further into type 3a and type 3b with the defining feature being the presence or absence of a history of psychiatric problems. Finally, type 4 encompasses atraumatic involuntary subluxation. Similarly to the FEDS system, the Rockwood-Matsen classification relies on the patient's history; however, it does not include direction.

Schneeberger and Gerber[29] developed a classification system that attempted to apply a more holistic approach to the instability patient by evaluating overall joint laxity. This classification is unique because it takes into consideration the overall generalized laxity of a patient and does not exclusively focus on the shoulder. However, this classification does not include the primary direction of instability or discriminate between subluxations and episodes of frank dislocation.

We recognize that the FEDS classification is quite extensive, with 36 possible categories. However, in our cohort of patients, only 16 of the categories represented greater than 1% of our study population and should be focused on. The FEDS system does not take into account systemic laxity, but patients with systemic laxity are typically included in the groups with multiple, atraumatic events. With the differences in etiology and treatment for posterior instability, we believe that direction should be included in a classification system.

The most common patient in our cohort had STAD. An interesting finding was that these patients were significantly older at initial presentation (mean age, 40.7 years). This age difference was not unexpected given the well-established bimodal age distribution of shoulder instability patients.[30] The next most common patient had OTAD. Overall, patients with a traumatic anterior dislocation accounted for 48.8% of the study population, with 50.8% having a single event, 33.7% having occasional events, and 15.5% having frequent events. These patients make up the previously well-described traumatic anterior shoulder instability, or TUBS, category.[32]

Multidirectional instability is commonly used both in the literature and in clinical practice and is defined as instability occurring in either 2 or 3 directions, with no clear consensus.[1,14,17,19,23,25] The term was first coined by Neer and Foster[20] in 1980 in a cohort of 36 patients with involuntary inferior and multidirectional subluxation and dislocation in whom standard surgical procedures had failed. More recently, authors have based the definition on physical examination findings alone even in the absence of symptoms.[1,4] The shoulder capsule has been described as a circle, which is unlikely to be injured in only 1 direction. This theory has been proved both biomechanically and clinically, with the theory being that every patient with shoulder instability has some laxity in more than 1 direction.[22,35] This lack of consensus creates confusion in the literature and makes it difficult to apply published data to clinical practice. The FEDS system is beneficial in having patients identify the direction in which their shoulder subluxates the majority of the time or using physical examination where the shoulder is the most unstable. This places patients whose instability has been previously classified as "multidirectional" into 1 distinct category. The FEDS classification that most closely resembles the classic and most common definition of multidirectional instability would be frequent, atraumatic subluxation in any direction (frequent, atraumatic, anterior subluxation [FAAS]; frequent, atraumatic, inferior subluxation [FAIS]; and frequent, atraumatic, posterior subluxation [FAPS]). The incidence in our cohort was 5.2% (20 of 383 patients); this is similar to the reported incidence of multidirectional instability in the shoulder instability population, which has been between 1.2% and 8.3%.[17] The "multidirectional instability categories" were also the only categories that predominantly comprised female patients (FAAS, 69.2%; FAPS, 60.0%), consistent with previous studies.

A concern with the FEDS classification is the multitude of potential groups: 36 in total. In this epidemiologic study, we show that only 16 of these categories are clinically significant. A frequent concern with other previously described instability classifications is being too narrow. With very few unique groups, clinicians find themselves attempting to fit patients into specific categories in which they do not fit or not being able to classify patients at all. The broadness of the FEDS classification system should alleviate these concerns and find a place for all patients.

There are several limitations within this epidemiologic study. First, our analysis is retrospective in nature, resulting in all confounding and bias inherent to all studies of this design. Some of the records with instability could not be classified. However, we were pleasantly surprised to find that 59.6% of patients were able to be classified without the involved physicians knowing the classification system, speaking to the ease of using the system. In addition, all patients were from tertiary referral centers, so there may be some differences in the epidemiology of patients in a general practice. We also report data on those patients who went on to undergo surgery and those who had recurrence of instability after undergoing an operation. Given the retrospective nature of this study, the variables that go into surgical decision making were obviously not controlled for. However, given the multiple institutions and multiple surgeons treating these patients, we hope to have

captured many different practice patterns, improving the generalizability of our results.

The strengths include the large number of patients at multiple sites; moreover, these data were taken from across various health care systems including primary care departments, not just orthopedics. In summary, the FEDS classification can be used to classify all patients with shoulder instability, with 16 of the categories encompassing all patients with at least a 1% incidence in our epidemiologic study.

Conclusion

Shoulder instability is a common problem within the general population and can be a source of long-standing pain and dysfunction, specifically for a young athlete. There has been much confusion in the literature on the definition of instability and how to classify patients with instability to assist in clinical outcomes-based research. The FEDS classification was developed to clarify confusion in the literature and provide a thorough and reproducible system to classify patients with instability. It is heavily dependent on the patient's history, does not rely on imaging or intraoperative findings, and can be supplemented with a physical examination to confirm the primary direction of instability only if necessary. The FEDS classification system has previously been shown to help predict which patients have a higher likelihood of undergoing surgery, and the interobserver and intraobserver reliability has been previously validated.[12,13] There are 16 categories within the FEDS classification that are clinically significant. STAD and OTAD were the most frequently observed in our cohort.

Acknowledgments

The authors acknowledge use of the Research Electronic Data Capture system (Vanderbilt University).

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Bak K, Spring BJ, Henderson JP. Inferior capsular shift procedure in athletes with multidirectional instability based on isolated capsular and ligamentous redundancy. Am J Sports Med 2000;28:466-71.
2. Bak K, Wiesler ER, Poehling GG, ISAKOS Upper Extremity Committee. Consensus statement on shoulder instability. Arthroscopy 2010;26:249-55. http://dx.doi.org/10.1016/j.arthro.2009.06.022
3. Cofield RH, Irving JF. Evaluation and classification of shoulder instability. With special reference to examination under anesthesia. Clin Orthop Relat Res 1987:32-43.
4. Cooper RA, Brems JJ. The inferior capsular-shift procedure for multidirectional instability of the shoulder. J Bone Joint Surg Am 1992;74:1516-21.
5. Farrar NG, Malal JJ, Fischer J, Waseem M. An overview of shoulder instability and its management. Open Orthop J 2013;7:338-46. http://dx.doi.org/10.2174/1874325001307010338
6. Gerber C, Nyffeler RW. Classification of glenohumeral joint instability. Clin Orthop Relat Res 2002:65-76.
7. Hao YD, Cui F, Zhu WH, Lu LY, Wang YB. Evaluation of the clinical significance of classification of traumatic anterior shoulder instability using double-contrast computed tomography arthrography. J Int Med Res 2011;39:424-34. http://dx.doi.org/10.1177/147323001103900210
8. Hovelius L. Incidence of shoulder dislocation in Sweden. Clin Orthop Relat Res 1982:127-31.
9. Johansson K. Multidirectional instability of the glenohumeral joint: an unstable classification resulting in uncertain evidence-based practice. Br J Sports Med 2016;50:1105-6. http://dx.doi.org/10.1136/bjsports-2016-096094
10. Joseph TA, Williams JS Jr, Brems JJ. Laser capsulorrhaphy for multidirectional instability of the shoulder. An outcomes study and proposed classification system. Am J Sports Med 2003;31:26-35. http://dx.doi.org/10.1177/03635465030310011601
11. Kuhn JE. A new classification system for shoulder instability. Br J Sports Med 2010;44:341-6. http://dx.doi.org/10.1136/bjsm.2009.071183
12. Kuhn JE, Helmer TT, Dunn WR, Throckmorton VT. Development and reliability testing of the frequency, etiology, direction, and severity (FEDS) system for classifying glenohumeral instability. J Shoulder Elbow Surg 2011;20:548-56. http://dx.doi.org/10.1016/j.jse.2010.10.027
13. Lebus GF V, Raynor MB, Nwosu SK, Wagstrom E, Jani SS, Carey JL, et al. Predictors for surgery in shoulder instability: a retrospective cohort study using the FEDS system. Orthop J Sports Med 2015;3:2325967115607434. http://dx.doi.org/10.1177/2325967115607434
14. Lo IK, Bishop JY, Miniaci A, Flatow EL. Multidirectional instability: surgical decision making. Instr Course Lect 2004;53:565-72.
15. Lo IK, Nonweiler B, Woolfrey M, Litchfield R, Kirkley A. An evaluation of the apprehension, relocation, and surprise tests for anterior shoulder instability. Am J Sports Med 2004;32:301-7. http://dx.doi.org/10.1177/0095399703258690
16. Maruyama K, Sano S, Saito K, Yamaguchi Y. Trauma-instability-voluntarism classification for glenohumeral instability. J Shoulder Elbow Surg 1995;4:194-8.
17. McFarland EG, Kim TK, Park HB, Neira CA, Gutierrez MI. The effect of variation in definition on the diagnosis of multidirectional instability of the shoulder. J Bone Joint Surg Am 2003;85:2138-44.
18. Moroder P, Scheibel M. ABC classification of posterior shoulder instability. Obere Extrem 2017;12:66-74. http://dx.doi.org/10.1007/s11678-017-0404-6
19. Neer CS II. Involuntary inferior and multidirectional instability of the shoulder: etiology, recognition, and treatment. Instr Course Lect 1985;34:232-8.
20. Neer CS II, Foster CR. Inferior capsular shift for involuntary inferior and multidirectional instability of the shoulder. A preliminary report. J Bone Joint Surg Am 1980;62:897-908.
21. Nordqvist A, Petersson CJ. Incidence and causes of shoulder girdle injuries in an urban population. J Shoulder Elbow Surg 1995;4:107-12.
22. Ovesen J, Nielsen S. Anterior and posterior shoulder instability. A cadaver study. Acta Orthop Scand 1986;57:324-7.
23. Pollock RG, Owens JM, Flatow EL, Bigliani LU. Operative results of the inferior capsular shift procedure for multidirectional instability of the shoulder. J Bone Joint Surg Am 2000;82:919-28.
24. Protzman RR. Anterior instability of the shoulder. J Bone Joint Surg Am 1980;62:909-18.

25. Richards RR. The diagnostic definition of multidirectional instability of the shoulder: searching for direction. J Bone Joint Surg Am 2003;85:2145-6.
26. Robinson CM, Aderinto J. Posterior shoulder dislocations and fracture-dislocations. J Bone Joint Surg Am 2005;87:639-50. http://dx.doi.org/10.2106/JBJS.D.02371
27. Robinson CM, Seah M, Akhtar MA. The epidemiology, risk of recurrence, and functional outcome after an acute traumatic posterior dislocation of the shoulder. J Bone Joint Surg Am 2011;93:1605-13. http://dx.doi.org/10.2106/JBJS.J.00973
28. Rockwood CA Jr, Matsen FA III. The shoulder. Philadelphia: Saunders; 1990.
29. Schneeberger AG, Gerber C. [Classification and therapy of the unstable shoulder]. Ther Umsch 1998;55:187-91 [in German].
30. Shields DW, Jefferies JG, Brooksbank AJ, Millar N, Jenkins PJ. Epidemiology of glenohumeral dislocation and subsequent instability in an urban population. J Shoulder Elbow Surg 2018;27:189-95. http://dx.doi.org/10.1016/j.jse.2017.09.006
31. Simonet WT, Melton LJ III, Cofield RH, Ilstrup DM. Incidence of anterior shoulder dislocation in Olmsted County, Minnesota. Clin Orthop Relat Res 1984:186-91.
32. Thomas SC, Matsen FA III. An approach to the repair of avulsion of the glenohumeral ligaments in the management of traumatic anterior glenohumeral instability. J Bone Joint Surg Am 1989;71:506-13.
33. Tzannes A, Paxinos A, Callanan M, Murrell GA. An assessment of the interexaminer reliability of tests for shoulder instability. J Shoulder Elbow Surg 2004;13:18-23. http://dx.doi.org/10.1016/S1058274603002453
34. Warby SA, Watson L, Ford JJ, Hahne AJ, Pizzari T. Multidirectional instability of the glenohumeral joint: etiology, classification, assessment, and management. J Hand Ther 2017;30:175-81. http://dx.doi.org/10.1016/j.jht.2017.03.005
35. Warner JJ, Micheli LJ, Arslanian LE, Kennedy J, Kennedy R. Patterns of flexibility, laxity, and strength in normal shoulders and shoulders with instability and impingement. Am J Sports Med 1990;18:366-75.