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Comparison of the posterolateral rotatory drawer test and magnetic resonance imaging in diagnosing chronic lateral collateral ligament insufficiency of the elbow

Labib Syed, MBBS, MRCS[a,*], *Sayeda Nahar, MBChB*[b], *Fiona Bintcliffe, FRCS (Tr&Orth)*[a], *David Yu, FRCR (Radiology)*[c], and *Joideep Phadnis, FRCS (Tr&Orth), PhD*[a,d]

[a]Department of Trauma and Orthopaedics, University Hospitals Sussex NHS Foundation Trust, Brighton, UK
[b]Department of Medicine, West Hertfordshire Teaching Hospitals NHS Trust, Watford, UK
[c]Department of Radiology, University Hospitals Sussex NHS Foundation Trust, Brighton, UK
[d]Honorary Reader, Brighton & Sussex Medical School, Brighton, UK

ABSTRACT

Background: Lateral collateral ligament (LCL) insufficiency of the elbow can be diagnosed using various clinical examinations. Among them, the posterolateral rotatory drawer (PLRD) test has been reported to have high sensitivity and specificity. Magnetic resonance imaging (MRI) is also frequently used to assess the LCL complex but studies show variable efficacy, raising doubt about its reliability as a gold standard diagnostic tool. Currently, no comparative studies exist between clinical testing and advanced imaging for LCL insufficiency. Hence, the aim of this study is to directly compare the PLRD test and MRI in terms of sensitivity and specificity for diagnosing LCL insufficiency.

Methods: We conducted a retrospective study using data from a single surgeon's database, including patients who underwent elbow arthroscopy (gold standard), MRI, and preoperative PLRD test between April 2017 and April 2025. All patients had MRI reviewed by consultant specialist musculoskeletal radiologists. Sensitivity and specificity of the PLRD test and MRI was calculated using arthroscopy as the reference standard for LCL insufficiency.

Results: Eighty-one patients were eligible for inclusion. Of these, 14 had a positive PLRD test, 9 had positive MRI findings, and 14 had positive arthroscopic findings. The PLRD test demonstrated a sensitivity of 85.7% (95% CI 57.2%-98.2%) and specificity of 97.0% (95% CI 89.6%-99.6%). In contrast, MRI had a sensitivity of 42.9% (95% CI 17.7%-71.1%) and a specificity of 95.5% (95% CI 87.5%-99.1%).

Conclusion: In our cohort, the PLRD test outperformed MRI in diagnosing LCL insufficiency. It is important for clinicians to be aware that a negative MRI does not preclude the presence of LCL insufficiency, and we recommend the PLRD test be used as the primary preoperative clinical assessment tool.

Level of evidence: Level III; Diagnosis Study

Institutional review board approval was not required as this work is derived from anonymized data.

*Reprint requests: Labib Syed, MBBS, MRCS, Royal Sussex County Hospital, Eastern Road, Brighton BN2 5BE, UK.
E-mail address: Labib.syed1@outlook.com (L. Syed).

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The elbow is a relatively stable joint, yet when injured, it presents a notable risk of recurrent instability, which may result in long-term disability and the development of arthritis.[31] As such, accurate identification of common instability patterns is critical for optimal management.

Elbow joint stability is afforded by 3 key articulations: the ulnohumeral, radiocapitellar, and proximal radioulnar joints.[5] The ulnohumeral joint serves as the primary stabilizing structure, supported by the medial collateral ligament (MCL) and lateral collateral ligament (LCL) complex.[2,31] These components function as the primary (static) stabilizers, whereas the muscles that cross the elbow joint provide secondary (dynamic) stability.[15,31] The MCL is crucial for preserving valgus and internal rotation stability, whereas the LCL complex is salient in resisting varus and external rotatory forces.[27,29]

Posterolateral rotatory instability (PLRI) is the most frequently encountered form of elbow instability.[4,9,24,25] It commonly manifests with pain, stiffness, hypermobility, and in more severe cases, overt instability, including subluxation or dislocation.[9] A defining feature of PLRI is insufficiency of the LCL complex, which comprises the annular ligament, radial collateral ligament, and lateral ulnar collateral ligament (LUCL), all of which serve as primary stabilizers against PLRI.[4,12,17,24] The LUCL, in particular, carries a significant role, with studies evidencing that isolated reconstruction of the LUCL has the potential to restore PLRI of the elbow.[13,21] LCL insufficiency results in transient external rotatory subluxation of the radius relative to the humerus, coupled with posterior and valgus displacement, leading to varus and external rotational instability.[2,6,20] This instability may arise from traumatic injury, iatrogenic causes, or degenerative changes in lateral soft tissues, as seen in conditions such as chronic cubitus varus or extensor tendinopathies (eg, "tennis elbow").[4,7,19,28] The elbow is particularly vulnerable to varus stress due to the arm's functional positioning during daily activities, where the weight of the forearm and the force of gravity impose varus torque on the joint when it is held away from the body.[31] Consequently, LCL injuries are poorly tolerated.

Several techniques are available to assess LCL insufficiency and diagnose PLRI, although there remains ongoing debate regarding the most effective diagnostic method. Because of the variability in clinical presentations, a high index of suspicion is often required for accurate diagnosis. Commonly employed physical examination tests include the posterolateral rotatory drawer (PLRD) test, lateral pivot-shift test, prone push-up test, chair push-up test, and tabletop push-up test.[7,8] In addition, imaging modalities such as radiography, magnetic resonance imaging (MRI), dynamic fluoroscopy, and dynamic ultrasonography can be used to aid in diagnosis.[8]

The PLRD test has high sensitivity and specificity (>90%) for diagnosing PLRI in both conscious and anesthetized patients.[9,29] Its advantages include its reliability in assessing instability, applicability in both clinical and intraoperative settings, and its utility in identifying iatrogenic complications and aiding preoperative planning.[9] However, its accuracy is contingent on the examiner's proficiency in performing the maneuver and the patient's level of relaxation.[9]

MRI offers detailed visualization of soft tissues and articular surfaces, enabling the identification of disruptions to the LCL or elbow incongruity.[8,23] However, the effectiveness of MRI for diagnosing LCL complex injuries remains a matter of debate.[16,30] Current literature suggests that imaging modalities, including MRI, are significantly less sensitive and specific than clinical examination methods for detecting LCL insufficiency.[31] Studies have demonstrated that MRI identifies the LUCL in only 50% of asymptomatic individuals and lacks the objectivity required to serve as a definitive diagnostic tool when compared to the PRLD test.[10,18,29,30] This limitation is attributed to the static nature of MRI, which complicates joint positioning and often leads to inadequate visualization of the LCL, making it difficult to identify dynamic or recurrent instabilities.[8,23,31] This article will critically assess and compare the diagnostic efficacy of the PLRD test and MRI in terms of sensitivity and specificity for detecting chronic LCL insufficiency of the elbow. We hypothesized that the PLRD test is as effective as MRI in diagnosing LCL insufficiency.

Materials and methods

This is a retrospective study using a single-surgeon (J.P.) database of patients who had undergone elbow arthroscopy between April 2017 and April 2025 for nonarthritic elbow pathologies. The PLRD test was routinely performed in the preoperative outpatient assessment of these patients. The aim of the study was to compare the efficacy of the PLRD test with MRI against a gold standard for diagnosing PLRI.

Arthroscopic assessment was chosen as reference standard for diagnosis of PLRI based on the ability to perform direct, dynamic visualization of the joint and quantification of the degree of instability.[1,22,24,29]

Eligibility

For inclusion, all patients required the following:

1) A clearly documented preoperative awake PLRD test performed in the outpatient clinic. The PLRD was graded as in Table I.
2) A preoperative good-quality MRI scan reported by a musculoskeletal radiologist. Scans without a musculoskeletal radiologist report were rereviewed by one of the authors (D.Y.) who is a consultant musculoskeletal radiologist.
3) An elbow arthroscopy including evaluation of all 3 elbow compartments with clear documentation of the presence or

Table I – PLRD grade to quantify the degree of laxity

Posterolateral rotatory drawer test (PLRD) grade	Interpretation
0	No laxity or subluxation
1	Lax but symmetrical to contralateral elbow (physiological laxity)
2	Lax and asymmetric to contralateral elbow (pathologic laxity)
3	Lax with palpable clunk often appreciated by patient and examiner (pathologic laxity)

absence of PLRI using standardized arthroscopic instability testing as previously described by the senior author (J.P.).[1]

Patients who had poor-quality MRI scans were excluded, as were those with unclear documentation of either preoperative or intraoperative instability findings. Patients undergoing arthroscopy for arthritis or stiffness were excluded to ensure reliability of arthroscopic instability findings. Patients with acute trauma such as a radial head or coronoid fracture were not included as this group is known to have ligamentous disruption.

PLRD test examination technique

The PLRD test is performed in the outpatient setting with the patient supine and their arm elevated overhead, allowing control of humeral rotation.[9,24,29] The examiner stands at the head of the bed, adjusting the bed height so that the patient's hands rest on the examiner's hip. The patient's elbow is flexed to approximately 30°-40°, with the forearm slightly supinated.[29] The degree of flexion and rotation can be varied and does not need to be performed in one exact position. During the examination, it is helpful to relax the patient for ease of assessment. The nonsymptomatic elbow is examined first to establish the patient's baseline level of physiological laxity, which is considered normal. This also helps to relax the patient. For the right elbow, the examiner controls the patient's humerus with their left hand and holds the forearm in the right hand. The examiner's thumb is used to localize the radial head, following which a posterior-directed force is applied using the fingers on the proximal radius (Fig. 1). This is done without gripping too hard.[9,29] For the left elbow, the examiner's hand position is reversed. The test can also be performed standing on the outside of the patient's elbow rather than between the elbows; however, we prefer the latter because it allows efficient comparison of both elbows.

The degree of instability is graded in comparison to the unaffected elbow (Table I). Grades 2 and 3 draws are considered pathologic, whereas grade 1 denotes physiologic laxity. Grade 3 draw is associated with a clear clunk, whereas grade 2 produces increased translation compared with the unaffected elbow without a clunk.[9,29] There are circumstances in which performing the PLRD test can be challenging. For instance, patients with marked stiffness, arthritis, or painful acute instability/fractures sometimes pose difficulty; however, these patients with acute pathology were not included in the present study.

Figure 1 – Positioning to perform the posterolateral rotatory drawer test (PLRD) test.

Magnetic resonance imaging

MRI scans were conducted as part of the evaluation of patients presenting to our clinic most often for elbow tendinopathies or when chronic ligamentous injuries were suspected. MRI scans were not used routinely in acute traumatic injuries. Several patients were referred to the clinic for assessment with an existing MRI scan performed in primary care. Only MRI scans reported by a specialist musculoskeletal radiologist were included. MRI scans reported by nonmusculoskeletal consultants or junior-grade radiologists were independently reviewed by a musculoskeletal radiologist (D.Y.). MRI elbow scans reviewed were acquired on a 1.5-tesla magnet with a minimum standard protocol containing a small field of view coronal and axial T1-weighted and proton density fat saturation (PDFS) sequence with a sagittal PDFS spectral adiabatic inversion recovery sequence. For the purpose of this study, MRIs reporting either a complete or partial tear were classified as a positive scan finding for LCL injury.

Arthroscopy

Elbow arthroscopy was performed under general anesthesia with a regional block. Patients were positioned in the lateral decubitus position, with the arm in a mobile arm holder (Trimano; Arthrex, Naples, FL, USA). The posterior, posterolateral, and anterior compartments of the elbow were systematically evaluated using routine, reproducible arthroscopic tests, including the posterolateral supination test, axial pull test, drive-through sign, and visualization of the LCL.[1,29] These tests form part of the routine diagnostic arthroscopic examination used in the senior author's practice. Presence of positive findings was recorded as diagnostic of instability.

Statistical analysis

All statistical analysis was conducted on MedCalc Software Ltd.[33] Sensitivities, specificities, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated for both PLRD test and MRI.

The study protocol was assessed using the NHS Health Research Authority (HRA) decision tool, which determined that formal review by the NHS Research Ethics Committee was not required.[34]

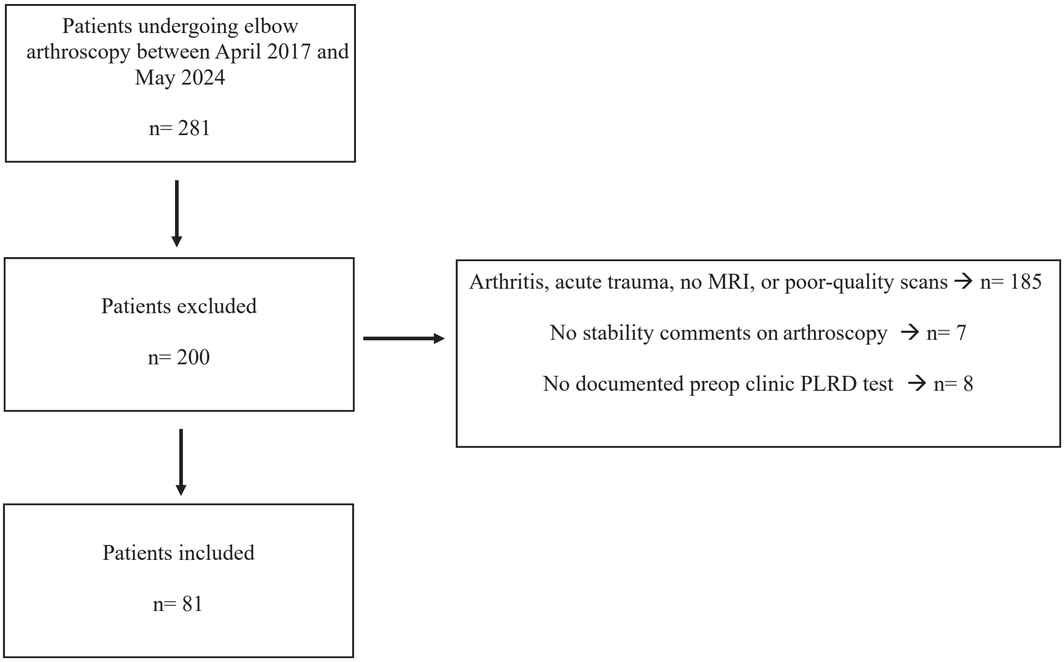

Figure 2 – Summary of patients excluded before establishing the final included cohort. *MRI*, magnetic resonance imaging; *PLRD*, posterolateral rotatory drawer.

Results

Patients

Patients undergoing arthroscopy were extracted from the senior authors database. Two hundred eighty-one patients were identified in the study period. After application of the inclusion and exclusion criteria, 200 patients were excluded. Of these, 185 either had arthroscopy for arthritis or acute trauma, did not have MRI scans, or had poor-quality scans. Seven patients had arthroscopies without clear comments on stability, and 8 patients did not have clearly documented preoperative clinic PLRD test result. A summary of the patients excluded can be seen in Fig. 2.

Eighty-one patients were deemed eligible, which included 38 females (47%) and 43 males (53%). There were 46 right-side elbows (57%) and 35 left-side elbows (43%). The mean age of patients was 33.5 years (range 11-78 years, standard deviation 15.4). Presenting symptoms included 62 patients (76.5%) with lateral or posterolateral elbow pain, 9 patients (11.1%) reporting instability symptoms, 4 patients (4.9%) with medial or posteromedial elbow pain, and 5 patients (6.2%) with anterior or anterolateral elbow pain. Two patients (2.5%) presented with elbow stiffness. Table II demonstrates a summary of patient characteristics.

Table II – Summary of patient demographics (N = 81)

Characteristic	Value
Gender, n (%)	
Male	43 (53)
Female	38 (47)
Age, yr, mean ± SD (range)	33.5 ± 15.4 (11-78)
Side of elbow involved, n (%)	
Right	46 (57)
Left	35 (43)

SD, standard deviation.

Arthroscopic procedures

Twenty-two patients underwent arthroscopic plica or synovitis excision, 17 patients underwent osteochondritis dissecans débridement, 13 patients had open or arthroscopic LCL repair or plication for LCL insufficiency, 6 patients had diagnostic arthroscopy with negative signs for LCL insufficiency, and 2 had open common extensor repair. Ten patients had arthroscopic tennis elbow release, 6 patients had loose body removal, 1 patient had excision of an elbow ganglion, 1 patient had arthroscopic retrograde capitellar drilling, 2 patients had débridement of osteophytes, and 1 patient had arthroscopic débridement for malunion.

PLRD test vs. MRI

Fourteen patients had a positive preoperative PLRD test, of which 12 (85.7%) had a positive arthroscopy (true positive) and 2 patients (14.3%) had a negative arthroscopy (false positive). Sixty-seven patients had a negative PLRD test, of which 65 (97.0%) had a negative arthroscopy (true negative) and 2 (3.0%) had positive arthroscopy (false negatives). Using arthroscopy as the reference standard, PLRD test had

Table III – Summary of results for the posterolateral rotatory draw test (PLRD) compared with arthroscopy as gold standard

Subjects	Arthroscopy positive	Arthroscopy negative	Total, n	
PLRD test positive, n (%)	12 (85.7)	2 (14.3)	14	PPV = 85.7%
PLRD test negative, n (%)	2 (3.0)	65 (97.0)	67	NPV = 97.0%
Total, n	14	67	81	Accuracy = 95.1%
	Sensitivity = 85.7%	Specificity = 97.0%		

PPV, positive predictive value; *NPV*, negative predictive value.

Table IV – Summary of results for MRI compared with arthroscopy as gold standard

Subjects	Arthroscopy positive	Arthroscopy negative	Total, n	
MRI positive, n (%)	6 (66.7)	3 (33.3)	9	PPV = 66.7%
MRI negative, n (%)	8 (11.1)	64 (88.9)	72	NPV = 88.9%
Total, n	14	67	81	Accuracy = 86.4%
	Sensitivity = 42.9%	Specificity = 95.5%		

MRI, magnetic resonance imaging; *PPV*, positive predictive value; *NPV*, negative predictive value.

a sensitivity of 85.7% (95% CI 57.2%-98.2%) and specificity of 97.0% (95% CI 89.6%-99.6%). The calculated PPV for PLRD test was 85.7% (95% CI 60.1%-96.0%) and NPV was 97.0% (95% CI 90.0%-99.2%). The accuracy for the PLRD test was 95.1% (95% CI 87.8%-98.6%).

Nine patients had a positive MRI, of which 6 (66.7%) had positive arthroscopy (true positive) and 3 (33.3%) patients had a negative arthroscopy (false positive). Seventy-two patients had a negative MRI result, of which 64 (88.9%) had a negative arthroscopy (true negative) and 8 (11.1%) had a positive arthroscopy (false negative). Using arthroscopy as the reference standard, MRI had a sensitivity of 42.9% (95% CI 17.7%-71.1%) and a specificity of 95.5% (95% CI 87.5%-99.1%). The PPV for MRI was 66.7% (95% CI 36.2%-85.4%), and the NPV was 88.9% (95% CI 83.5%-92.7%). The accuracy of MRI was 86.4% (95% CI 77.0%-93.0%). Tables III and IV demonstrate the summary of the results for PLRD test and MRI compared with arthroscopy as gold standard.

Discussion

To our knowledge, this is the first study to directly compare any preoperative diagnostic tests for the diagnosis of LCL insufficiency. The findings demonstrated that the PLRD test had superior diagnostic accuracy compared with MRI.

In the current literature, most studies assessing clinical tests for PLRI in awake patients involve small patient sample sizes and only include patients with the pathology being tested for (LCL insufficiency).[3,26] This restricts the ability of those studies to calculate specificity, PPV, NPV, and accuracy. Regan and Lapner[26] reported a sensitivity of 87.5% for both the prone push-up test and the chair push-up test in a cohort of 8 patients, whereas the lateral pivot-shift test had a much lower sensitivity of 38% in the same group. Arvind and Hargreaves[3] described their Table-Top Relocation Test as having a sensitivity of 100% in their cohort, which also consisted of 8 patients. However, neither study provided specificity or accuracy measures, as both only included subjects with confirmed PLRI pathology.

Goldin et al[14] suggested a new "Posterior Radiocapitellar Subluxation Test" to diagnose PLRI, with reported sensitivity of 77.5% and specificity of 80%. However, this was a cadaveric study on specimens and, therefore, cannot be extrapolated to large clinical populations.

Our group (Stone et al[29]) were the first to report both sensitivity and specificity of the PLRD test, in 106 patients. We reported a sensitivity of 94.7% and a specificity of 98.5%. In the design of that study, it was originally intended to use MRI and arthroscopy as gold standards for the presence of PLRI; however, in an initial pilot (unpublished), it became apparent that MRI was unreliable as a gold standard, because there was poor correlation with arthroscopy findings. It was this pilot study that led us to perform the present investigation.

In the current study, the calculated sensitivity and specificity of the PLRD test are comparable to those reported by Stone et al.[29] The discrepancy, particularly in relation to sensitivity, can be attributed to the smaller sample size, as this cohort required all patients to have undergone arthroscopy, MRI, and a documented preoperative PLRD test, leading to exclusion of more patients. It also, highlights that sensitivity and specificity tests need to be taken in context of the individual study parameters and cannot necessarily be applied across all patient and clinician populations.

The inconsistency of MRI in identifying LCL insufficiency in our study has been reported in the literature previously.[11,16,18,30] Although direct evaluation of the LCL integrity with MRI is acknowledged to have limitations, Hackl et al[18] postulated that evaluating radiocapitellar and ulnohumeral joint congruity on MRI could also offer useful diagnostic information. They proposed that posterior translation of the radial head greater than 2 mm and ulnohumeral joint incongruity exceeding 1 mm may suggest elbow instability.[18] Limitations to this methodology include the static nature of MRI, variation in image interpretation, and correlation with clinical instability. In the United Kingdom, the average current cost of an MRI scan is around £173, making it the most expensive routine imaging modality.[32] Dynamic fluoroscopy and ultrasonography have been described as useful adjuncts in assessment in patients presenting with suspected PLRI and may yet demonstrate superiority over MRI.[7,8] Camp et al[7] demonstrated that the sonographic posterolateral rotatory stress test could detect increased ulnohumeral laxity in patients with clinically positive PLRD and lateral pivot shift tests.

The PLRD test was originally described by O'Driscoll,[24] who reported high sensitivity in awake, non-anesthetized patients consistent with the results of our study.[29] In our practice, the PLRD test is performed with a slight variation by standing between both elbows rather than to the side of each elbow for the purpose of efficient contralateral elbow examination. We do not feel this affects the reliability of the test and emphasizes the need to examine the normal elbow for baseline laxity. Similarly, the grading score used by the senior author in our practice has not been formally validated but acknowledges the difference between pathologic and physiological laxity, which is important to avoid overtreatment of laxity. Progressive laxity leading to instability has been demonstrated by sequential sectioning of the lateral soft tissues in a cadaveric study[7] and is consistent with what we see clinically when grading the PLRD test, where grades 2 and 3 are classified as pathologic but have different examination findings (clunk vs. no clunk).

A limitation of this study is that the PLRD tests and arthroscopies were all performed by a high-volume elbow specialist. Therefore, the sensitivity, specificity, and accuracy are likely to be higher compared with a nonspecialist. However, the PLRD test is an easily reproducible examination that can be learned and practiced similarly to other routine orthopedic assessments. We feel that incorporating this test into orthopedic training will improve widespread use and proficiency of examination similar to any commonly performed test used in current orthopedic practice.

A further limitation is that some patients with poor-quality scans were excluded from the study. These scans were usually affected by movement artifact, making the LCL complex difficult to appreciate to provide an accurate report. This may have affected the test results of MRI; however, it reflects a normal issue and limitation encountered with MRI in clinical practice. In addition, all MRI scans were plain MRI without arthrograms. Hence, we cannot comment on the relative efficacy of MRI arthrogram, which may show different results but is not part of our routine clinical practice.

MRI scans were reported by more than 1 musculoskeletal radiologist; hence interpretation may not be standardized. Nevertheless, all were consultant radiologists specializing in musculoskeletal radiology with a minimum of 10 years' experience. Additionally, this study compares a single surgeon's diagnostic accuracy to multiple musculoskeletal radiologists; however, these limitations are reflective of real-world practice.

Finally, although the cohort of patients included in this study is larger than virtually all comparable studies, it is still relatively small, which reflects the infrequency with which chronic LCL insufficiency is encountered.

Conclusion

The PLRD test was demonstrated to have superior sensitivity and specificity compared with MRI in diagnosing LCL insufficiency. We would recommend that the PLRD test be used as the primary diagnostic tool for assessment of chronic LCL insufficiency with advanced imaging used as a diagnostic adjunct. Clinicians should be aware that an MRI has only 43% chance of identifying PLRI, and therefore a negative MRI does not exclude the presence of LCL insufficiency.

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