Myocardial Strain Imaging

Clinical Policy ID: CCP.1207

Recent review date: 6/2026

Next review date: 10/2027

Policy contains: Deformation imaging; echocardiographic strain imaging; hypertrophic cardiomyopathy; myocardial strain; and speckle-tracking.

Coverage policy

Echocardiographic assessment of myocardial strain to measure cardiac impairment is investigational/not clinically proven and, therefore, not medically necessary.

Limitations

No limitations were identified for this policy.

Alternative covered services

- Cardiac magnetic resonance
- Chest radiography
- Computed tomography
- Electrocardiography
- Myocardial perfusion imaging
- Radionuclide ventriculography
- Stress echocardiography
- Transthoracic or transesophageal echocardiography, including tissue Doppler imaging

Background

Myocardial strain imaging evaluates the function of the heart muscle using cardiac ultrasound. In myocardial imaging, the terms “strain” and “strain rate” define myocardial wall deformation that occurs by the application of a force (Collier, 2017). Strain is a unitless measurement used to describe dimensional or deformational change resulting from local shortening, thickening, and lengthening of the myocardium during the cardiac cycle. The dimensions of strain are longitudinal, radial, circumferential, and rotational (ventricular twist). Strain rate quantifies the speed of myocardial deformation.

The amount of deformation (positive or negative strain) is defined as the percent change in the length of myocardial segment from a relaxed to contractile state (Collier, 2017). Positive strain values describe thickening, and negative values describe shortening, of a given myocardial segment related to its original length. Both strain and strain rate assess systolic function (especially regional contractile function) but are not measures of contractility, because deformation is load dependent (Voigt, 2019).

Myocardial deformation data may be derived noninvasively using echocardiography or cardiac magnetic resonance (Voigt, 2019). Transthoracic echocardiography is an established modality for ventricular wall motion analysis and assessment of regional myocardial function. Through tissue Doppler imaging, calculation of myocardial strain rate deformation became possible from apical windows with left ventricular shortening and lengthening with Doppler scan lines. However, tissue Doppler imaging provides a one-dimensional view and permits limited evaluation of deformation. It is highly operator dependent, and estimation of wall motion is visual and subjective with high interobserver and intra-observer variability.

Speckle-tracking echocardiography is a recent development based on two-dimensional digital gray-scale imaging on echocardiography, which is composed of several bright acoustic markers called “speckles” produced by the scatter of the ultrasound beam by the tissue (Voigt, 2019). Three-dimensional speckle-tracking is now available. The motion pattern of the speckles reflects the motion pattern of myocardial tissue at the endocardial border from which strain and strain rate can be calculated. It allows the myocardium, particularly the left ventricle, to be viewed at various angles during the echocardiographic procedure and provides unique quantifiable information on regional and global myocardial function.

Speckle-tracking echocardiography software is applied during post-processing to analyze regions of interest frame-by-frame, but the methods and algorithms are strongly vendor specific, leading to inter-vendor variability. The European Association of Cardiovascular Imaging and the American Society of Echocardiography initiated a consensus task force to standardize definitions and nomenclature in both atrial and ventricular strain imaging with two-dimensional speckle-tracking technology (Badano, 2018; Voigt, 2019). The goal of this effort was to reduce inter-vendor differences and ambiguities in the strain algorithms.

The most studied parameter using speckle-tracking data is global longitudinal strain, as it represents a shortening of the endocardial fibers that are usually the first affected in most cardiomyopathies (Voigt, 2019). Left ventricular ejection fraction is an established, but relatively late, load-dependent marker of systolic function, resulting in low sensitivity for detecting subclinical changes in ejection fraction. Myocardial strain analysis can discriminate between active and passive movement of myocardial segments and can permit separate assessment of the dimensional components of myocardial deformation that are not visually assessable on transthoracic echocardiography. As such, it has potentially wide clinical application for the diagnosis, prognosis, and provision of treatment of myocardial disease, in particular, chemotherapy-related cardiac dysfunction.

Findings

The most studied myocardial strain parameter is left ventricular global longitudinal strain by two-dimensional speckle-tracking echocardiography. Global longitudinal strain is a robust method and considered more sensitive than ejection fraction alone for diagnosing mild systolic dysfunction. Transthoracic echocardiography with strain imaging may provide a sensitive tool for risk assessment in the presence of normal left ventricular ejection fraction, for example, in patients taking cardiotoxic medications. When evaluating left ventricular dyssynchrony and ischemic dysfunction, mapping of segmental left ventricular strain may aid in differentiating specific cardiomyopathies. Indications for quantifying right ventricular function, atrial strain, and three-dimensional speckle-tracking echocardiography are emerging. Current evidence is insufficient to demonstrate the effect of myocardial strain imaging on clinical management or improvement in patient outcomes.

Guidelines

According to the European Association of Cardiovascular Imaging and the American Society of Echocardiography, efforts to reduce inter-vendor differences and ambiguities in strain algorithms have produced more homogeneity in recent editions of strain software from major vendors in chamber-specific functions. Longitudinal strain is robust and reproducible using most vendors' software and serves as a complementary parameter of global left ventricular function. The task force endorsed several indications for use. Sixteen indications were labeled as "may be appropriate," and 17 were labeled as "not currently endorsed" due to lack of evidence. The strongest clinical endorsements were for the following indications (Thomas, 2025):

- Diagnosis and prognosis of left ventricular ejection fraction and right ventricular ejection fraction in: acute and chronic myocardial infarction; valvular heart disease of at least moderate severity, single or multiple lesions; undifferentiated cardiomyopathy; acute and chronic heart failure; cardiac resynchronization therapy; differentiating cardiomyopathy from adaptive physiological remodeling of an Athlete's heart; and pulmonary hypertension
- Diagnosis and prognosis of left ventricular ejection fraction in cardio-oncology
- Diagnosis and prognosis of left atrial reservoir strain in acute and chronic heart failure.

An update from the American Society of Echocardiography recommends echocardiographic assessment of left ventricular global longitudinal strain and left atrial reservoir strain for estimating left ventricular filling pressures in patients who have heart failure with preserved left ventricular ejection fraction (Nagueh, 2025).

In pediatrics, the American Society of Echocardiography recommends two-dimensional speckle-tracking echocardiography as a complement to traditional geometric parameters (e.g., left ventricular shortening fraction or ejection fraction) in patients with congenital heart disease and abnormal ventricular geometry. Measurement of left ventricular global longitudinal strain may be incorporated into left ventricular functional protocols. In targeted populations, right ventricular and single ventricular global longitudinal strain, left ventricular circumferential strain, and regional strain pattern analysis may be useful (Lopez, 2024). There is a lack of evidence supporting the prognostic significance of early changes in left ventricular function determined by global longitudinal strain and recommended more data before incorporating strain measurement routinely in therapeutic decisions to monitor cardiotoxicity in cancer treatment (Mertens, 2023).

In 2019, the American College of Cardiology issued appropriate use criteria for multimodality imaging in the assessment of cardiac structure and function in nonvalvular heart disease.. For strain or strain rate imaging, four indications were rated as "appropriate" and represent clinical scenarios where the expected incremental information from speckle or tissue Doppler, combined with clinical judgment, may exceed the expected negative consequences. All other 77 indications were rated as "may be appropriate" (n = 14) or "rarely appropriate" (n = 63), reflecting the uncertainty in the clinical value of myocardial strain data using two-dimensional speckle-tracking for these scenarios. The four indications rated as "appropriate" are (Doherty, 2019):

- Initial evaluation prior to exposure to medications/radiation that could result in cardiotoxicity/heart failure
- Re-evaluation (one year) in a patient previously or currently undergoing therapy with potentially cardiotoxic agents
- Periodic re-evaluation in a patient undergoing therapy with cardiotoxic agents with worsening symptoms
- Evaluation of suspected hypertrophic cardiomyopathy to clarify initial diagnostic testing (commonly when transthoracic echocardiography is nondiagnostic)

The Writing Committee of the American Academy of Cardiology has published several additional guidelines that address the incremental value of myocardial functional information from strain imaging:

- In asymptomatic patients with severe primary mitral regurgitation (Stages B and C1), global longitudinal strain may be considered as an adjunct to guide the timing of intervention (Writing Committee, 2021).
- In patients presenting with signs and symptoms of heart failure, indices of myocardial deformation, such as global longitudinal strain, may identify subclinical left ventricular systolic dysfunction, which has been associated with greater risk of developing heart failure or recurrent heart failure hospitalizations (Heidenreich, 2022).
- For a clinical suspicion of amyloidosis, apical sparing of left ventricular longitudinal strain impairment can aid in diagnosis (Heidenreich, 2022).
- In patients with newly diagnosed or suspected atrial fibrillation, strain imaging may suggest an underlying infiltrative cardiomyopathy, such as amyloidosis (Writing Committee, 2024a).
- A comprehensive echocardiogram may include strain imaging in evaluating adults with repaired Tetralogy of Fallot to evaluate hemodynamic sequelae (Gurvitz, 2026).
- In patients with preclinical hypertrophic cardiomyopathy, changes in left ventricular systolic strain and diastolic function can precede definitive hypertrophy on echocardiography. However, the clinical significance of subclinical structural and functional abnormalities, such as myocardial strain, is unclear, and treatment decisions are usually not based on these findings alone (Writing Committee, 2024b).

To assess cardiac involvement in patients with primary systemic light chain amyloidosis, the National Comprehensive Cancer Network (2026) recommended transthoracic echocardiogram with global longitudinal strain imaging when cardiovascular magnetic resonance is not feasible or optimal in certain circumstances, but the guideline cited no supportive evidence for this use.

The American Society for Clinical Oncology guideline for preventing and monitoring cardiac dysfunction in adults with cancer endorsed routine echocardiography in individuals with metastatic breast cancer. It also recommended echocardiography in post-chemotherapy patients with signs and symptoms of cardiac disease, six to 12 months after chemotherapy in high-risk patients. If echocardiography is unavailable or not technically feasible, cardiac magnetic resonance imaging or multi-gated acquisition scans can be used. Reports in professional medical literature address these indications for myocardial strain imaging. However, none address whether the procedure affects eventual patient outcomes (Armenian, 2017).

<u>Evidence review</u>

Evidence from systematic reviews, meta-analyses, and large studies shows that myocardial strain metrics, particularly global longitudinal strain, are sensitive early markers of myocardial impairment, especially in the setting of a normal left ventricular ejection fraction. Several systematic reviews identified significant limitations in the literature that prevented meaningful evaluation of clinical efficacy through meta-analysis in most instances. The main limitations are the inclusion of only retrospective or prospective cohort studies and the large degree of heterogeneity among them. In particular, variation in strain values among methods, modalities, and software versions prevented determination of a clearly defined threshold value for left ventricular global longitudinal strain, which would trigger clinical action and potentially any subsequent impact on clinical care.

Early results suggested a potential complementary role for myocardial strain imaging to detect subclinical early left ventricular dysfunction in patients undergoing chemotherapy. Speckle-tracking echocardiography strain parameters showed significant reductions early in treatment that were not detected by other means. Worsened global longitudinal strain was associated with a higher risk of cardiac dysfunction, suggesting a potential prognostic role for strain imaging in monitoring preclinical changes in cardiac ventricular dysfunction, which may permit early treatment changes (Bergamini, 2019; Li, 2022; Oikonomou, 2019; Sonaglioni, 2025).

The body of literature is expanding beyond cardiotoxicity to strain imaging of atria or ventricles for early detection and outcome prediction, especially in the setting of normal left ventricular ejection fraction:

- To predict response to catheter ablation (Bajraktari, 2020; Nielsen, 2020)
- To predict response to cardiac resynchronization therapy using ventricular strain (Huang, 2025)
- For early detection of subclinical ventricular dysfunction associated with:
  - Systemic lupus erythematosus (Di Minno, 2020)
  - Sickle cell disease (Whipple, 2021)
  - Hypertensive pregnancy disorders (Edwards, 2025)
  - Acute cellular rejection in heart transplant recipients (Elkaryoni, 2020; Zhu, 2020)
  - Transcatheter aortic valve implantation/replacement (Goudarzi, 2026)
  - Non-alcoholic fatty liver disease (Gruber, 2025)
  - Cardiac amyloidosis (Ahmad, 2026; Sonaglioni, 2026)
  - Cardiomyopathy (Burhanuddin, 2025; Dorobantu, 2021; Tower-Rader, 2019)
  - Suspected pediatric myocarditis (Macierzanka, 2026)
- For prognosis using ventricular longitudinal strain:
  - In patients with coronavirus disease (Wibowo, 2021)
  - In patients with sepsis (Vallabhajosyula, 2019)
  - In patients with subclinical primary mitral regurgitation, to guide timing of mitral valve surgery (Modaragamage Dona, 2021)
  - In fetuses during gestation (van Oostrum, 2020a, 2020b)
  - In chronic obstructive pulmonary disease (Ranjini, 2025)
- For prognosis using atrial strain for:
  - New-onset atrial fibrillation (Golukhova, 2025)
  - Acute and chronic heart failure (Pastore, 2025)
  - Postoperative atrial fibrillation in adults undergoing cardiac surgery (Misra, 2026)
  - After repair of Tetralogy of Fallot (Cheung, 2019)

In 2022, we updated the references which warranted no policy changes.

In 2024, we reactivated and updated the policy, and changed coverage from medically necessary to investigational, based on guideline recommendations (Mertens, 2023) stating a lack of evidence that myocardial strain imaging affects outcomes.

In 2025, we updated the references and added a new guideline and research on the influence of amyloidosis on myocardial strain measurement and the potential use of myocardial strain imaging in this population. No policy changes are warranted.

In 2026, we updated the references and guideline recommendations. No policy changes are warranted.

References

On April 29, 2026, we searched PubMed and the databases of the Cochrane Library, the U.K. National Health Services Centre for Reviews and Dissemination, the Agency for Healthcare Research and Quality, and the

Centers for Medicare & Medicaid Services. Search terms were “echocardiographic strain imaging,” “deformation imaging,” “myocardial strain,” and “speckle tracking.” We included the best available evidence according to established evidence hierarchies (typically systematic reviews, meta-analyses, and full economic analyses, where available) and professional guidelines based on such evidence and clinical expertise.

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Policy updates

11/2015: initial review date and clinical policy effective date: 3/2016

11/2016: Policy references updated.

11/2017: Policy references updated.

11/2018: Policy references updated. Policy ID changed to CCP.1207.

1/2020: Policy references updated.

8/2021: Policy references updated. Coverage limitation clarified.

8/2022: Policy references updated.

6/2024: Policy re-activated and updated. Coverage modified from medically necessary to investigational.

6/2025: Policy references updated.

6/2026: Policy references updated.

Related codes

Below are the most commonly submitted codes for the service(s)/item(s) subject to this policy CCP.1207. This is not an exhaustive list of codes. Providers are expected to consult the appropriate coding manuals and bill accordingly.

Code	Code description
93356	Myocardial strain imaging using speckle tracking-derived assessment of myocardial mechanics (List separately in addition to codes for echocardiography imaging)