

# Left Ventricular Strain Imaging in Cardiomyopathy: A Comparative Study

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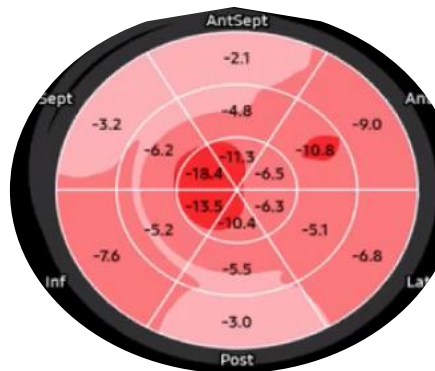
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## Introduction

### Background

GLS (global longitudinal strain) is an established method of quantifying left ventricular systolic function, in particular for the detection of subtle cardiomyopathies where ejection fraction is normal or near normal [1]. GLS is also of major importance in Cardiac Amyloidosis, where the examiner can find the typical “cherry on top” sign in the “Bull’s eye-plot” as shown in Figure 1 [2].



**Figure 1:** Bull’s eye-plot in a case with Cardiac AL-Amyloidosis

In the latest ESC guidelines on cardio-oncology [3], GLS is mentioned as an important element in diagnosing the cardiotoxicity of oncological therapy. A relative decrease in GLS of >15% during cancer treatment is the recommended cut-off point for suspecting subclinical cardiac dysfunction.

Samsung has released a left ventricular (LV) strain imaging feature, “Strain+” for LV. There is a known variability of LV strain between ultrasound vendors [4, 5]. TomTec has established a position as a vendor-neutral software for strain imaging [6]. This study aims to compare the LV Strain image performance of Samsung and TomTec.

Dr. Schwaiger is a Consultant Cardiologist, whose main position is Cardiology Consultant in the University Teaching Hospital of St. Johann in Tirol, where he is primarily responsible for Cardiac Pacing Procedures and advanced echocardiography.

This work relates to his private practice, which runs one day per week and is situated in Hall i.T., Austria. He is an experienced user of TomTec Image Arena Software for nearly three decades. In this practice, in 2023, a Samsung V7 ultrasound machine was purchased. An updated version (cV7) of the Samsung LV strain was installed on this machine in December 2024. In April 2025 a retrospective quality control study on LV strain on echocardiography datasets of patients with known or suspected cardiomyopathy was performed.

### Data and Methods

In this study, all echocardiography datasets of patients with known or suspected cardiomyopathy who presented between December 2024 and March 2025 were retrospectively analyzed. Left ventricular strain was measured on the Samsung cV7 Ultrasound machine. Data were then exported anonymized and evaluated again on the TOMTEC-Arena. Ejection fraction of the left ventricle was measured with the Auto-EF app of the Samsung cV7 Ultrasound machine.

## Image Quality

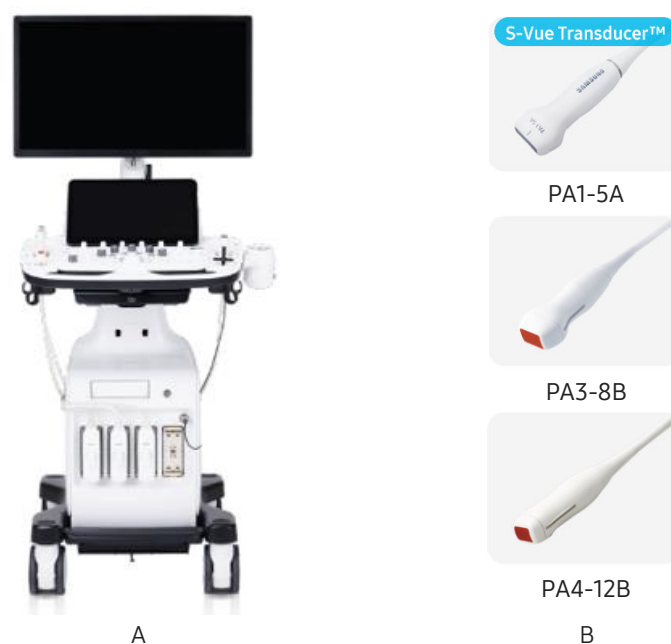
Image quality was visually assessed in the available 2D images of four, three, and two-chamber views. If all 18 segments of the LV-myocardium could clearly be followed in diastole and systole, image quality was classified as “very good”. If up to two segments could not be clearly depicted and followed during systole image quality was classified as “acceptable”. In case more than two segments could not clearly be visualized, the dataset was excluded.

## ECG Quality

A dataset was excluded if the Samsung cV7 was unable to sufficiently interpret the ECG signal in any of the three 2D clips per dataset, or in case heart rates were too different in the three 2D clips.

## System Requirements

For a comprehensive evaluation of cardiovascular diseases, high-resolution ultrasound systems like the Samsung cV8, cV7, cV6, or cV5, as shown in Figure 2A, equipped with phased array transducers, are indeed ideal. These systems offer the necessary features for detailed cardiac assessment.



**Figure 2.** (A) Samsung cardiovascular cV8 system and (B) recommended probes PA1-5A, PA3-8B, or PA4-12B to perform transthoracic echocardiography for the diagnosis of cardiovascular diseases.

1. Phased array transducers: Samsung PA1-5A, PA3-8B, or PA4-12B for cV8, cV7, cV6 systems, as shown in Figure 2B, are suitable for cardiac imaging, providing a small footprint for intercostal scanning and electronic beam steering capabilities. P1-5AE and PA3-9B are probes for the cV5 ultrasound system.
2. Imaging modes: Following imaging modes are helpful for comprehensive evaluation during transthoracic echocardiography.
  - 2D imaging
  - M-mode
  - Color Doppler
  - Pulsed Wave Doppler
  - Continuous Wave Doppler

- Tissue Doppler Imaging (TDI) and Tissue Wave Doppler (TWD)
3. Advanced features:
- Strain+ for LV: For assessing myocardial deformation
  - HeartAssist™: For automatic measurements
  - StressEcho: For evaluating cardiac performance under stress
  - AutoEF: Automatically measures ejection fraction and left ventricular volumes
  - Cardiac Measurements: For comprehensive quantitative analysis

These systems utilize high-frequency transducers, typically operating between 2-10 MHz, which provide excellent resolution for cardiac structures. The phased array design allows for a sector-shaped image, ideal for cardiac views through limited acoustic windows. The combination of these imaging modes and advanced features enables detailed diagnosis of various cardiovascular diseases, including valvular disorders, myocardial dysfunction, and congenital heart.

### Statistics

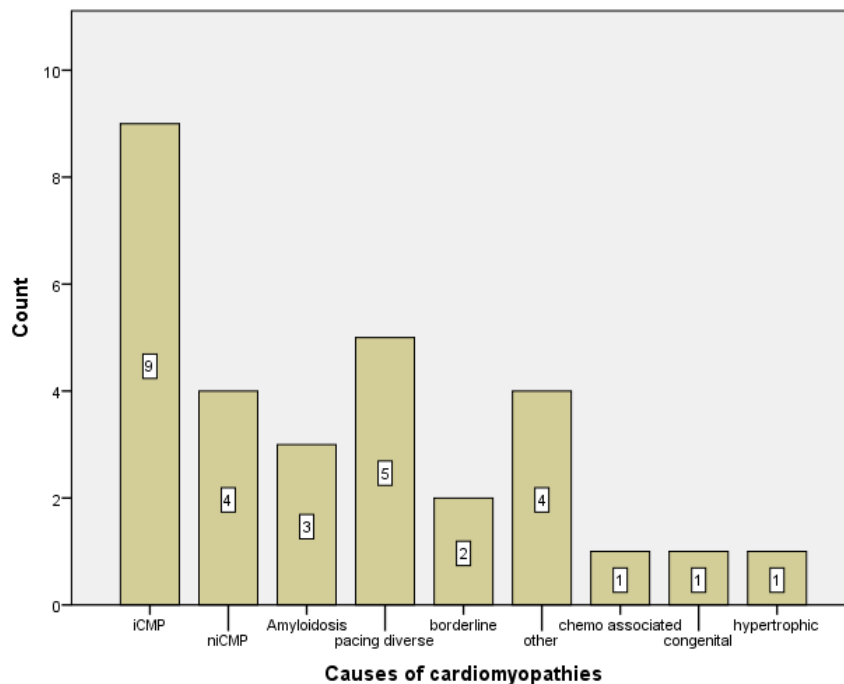
Data are presented as mean +/- standard deviation. A one-sample T-test was used to calculate the mean bias and its standard deviation. Bland-Altman plotting was used to depict the data.

### Patients

36 echocardiography datasets of patients with known or suspected cardiomyopathy were evaluated. Mean age of the patients was 62 +/- 14 years. Mean LVEF was 42 +/- 9.7 % [range 20-55]. Six datasets were excluded due to insufficient image or ECG quality.

### Cardiomyopathies

Among 30 patients, 9 patients had ischemic etiology; the remaining patients spread out over diverse entities, as shown in Figure 3. It is important to note that 10% of patients had a validated diagnosis of Cardiac Amyloidosis.



**Figure 3.** iCMP = ischemic cardiomyopathy; niCMP = both dilated and non-dilated, non-ischemic cardiomyopathies other: acute myocarditis; tachycardia; high output cardiac failure; dilated ventricle, probably athlete's heart.

## Results

### Left ventricular global longitudinal strain

Mean Samsung LV strain was  $-14.3 \pm 4.0\%$  and Mean TomTec LV strain was  $13.7 \pm 4.0\%$  as listed in Table 1. The p-value for the 2-sample t-Test was 0.022 ( $<0.050$ ). Mean difference was  $0.6 \pm 1.4\%$ . In 2CV (chamber view), the mean difference was the lowest, 0.2%. Table 2 shows the minimum and maximum values for the dataset for each category. Table 3 is the one-sample t-test result with standard mean error.

**Table 1.** GLS results

|     | Samsung |     | Tomtec |     | Mean Difference |     |
|-----|---------|-----|--------|-----|-----------------|-----|
|     | GLS     | SD  | GLS    | SD  | GLS             | SD  |
| GLS | -14.3   | 4.0 | -13.7  | 4.0 | 0.6             | 1.4 |
| 3CV | -14.7   | 5.0 | -13.8  | 4.6 | 0.9             | 2.3 |
| 4CV | -15.2   | 4.3 | -14.3  | 4.3 | 0.9             | 2.0 |
| 2CV | -13.0   | 4.0 | -12.9  | 3.3 | 0.2             | 2.1 |

**Table 2.** Descriptive Statistics

|                    | N  | Minimum | Maximum | Mean    | Std. Deviation |
|--------------------|----|---------|---------|---------|----------------|
| S GLS              | 30 | -20.8   | -6.0    | -14.317 | 3.9963         |
| T GLS              | 30 | -19.4   | -5.2    | -13.690 | 3.9154         |
| S 3CV              | 30 | -22.2   | -4.2    | -14.687 | 4.9966         |
| T 3CV              | 30 | -20.2   | -4.3    | -13.797 | 4.6526         |
| S 4CV              | 30 | -22.7   | -7.3    | -15.190 | 4.3397         |
| T 4CV              | 30 | -21.4   | -5.0    | -14.333 | 4.3179         |
| S 2CV              | 30 | -20.5   | -5.4    | -13.163 | 3.9985         |
| T 2CV              | 30 | -18.0   | -6.3    | -12.963 | 3.3026         |
| Valid N (listwise) | 30 |         |         |         |                |

**Table 3.** One-Sample Statistics

|              | N  | Mean   | Std. Deviation | Std. Mean Error |
|--------------|----|--------|----------------|-----------------|
| Diff GLS     | 30 | -0.627 | 1.4179         | 0.2589          |
| Diff 3CV GLS | 30 | -0.890 | 2.3379         | 0.4268          |
| Diff 4CV GLS | 30 | -0.857 | 2.0358         | 0.3717          |
| Diff 2CV GLS | 30 | -0.200 | 2.1676         | 0.3958          |

### Bland-Altman-Plot of global longitudinal strain (GLS)

The mean difference for the GLS between Samsung and TomTec was 0.6 +/- 1.4% as shown in Figure 4. The upper level of agreement was calculated as  $-0.6 + (1.96 \cdot 1.4)$ , the lower level of agreement was  $-0.6 - (1.96 \cdot 1.4)$ . Only in one dataset the measurement difference exceeds the lower level of agreement.

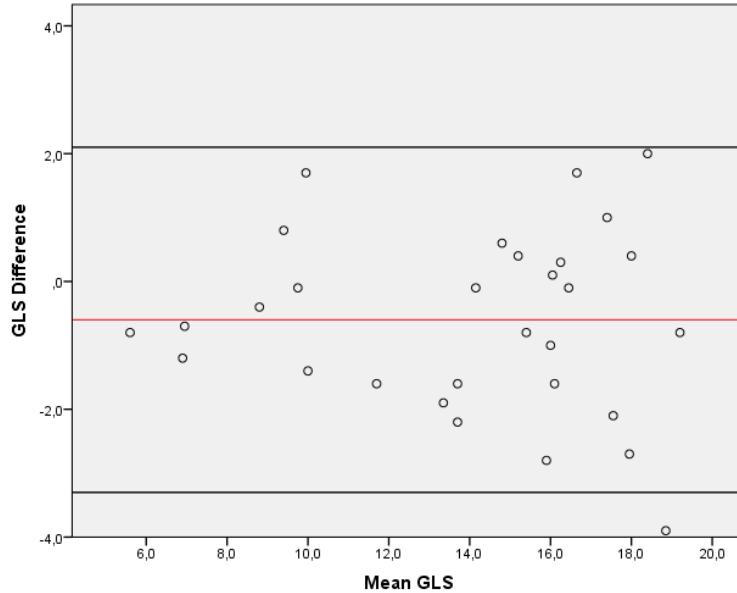


Figure 4. Bland-Altman-Plot

Note: For reasons of simplicity, the "Minus" in GLS is omitted

### GLS difference in categories

The difference in LV-strain measurements by Samsung and TomTec was <1% in 14 datasets, as shown in Figure 5. In 10 datasets (33%) difference was between 1 and 2%. In 5 datasets, the mean difference was between 2 and 3%. Only in one dataset the mean difference was out of the level of agreement in the Bland-Altman Plot.

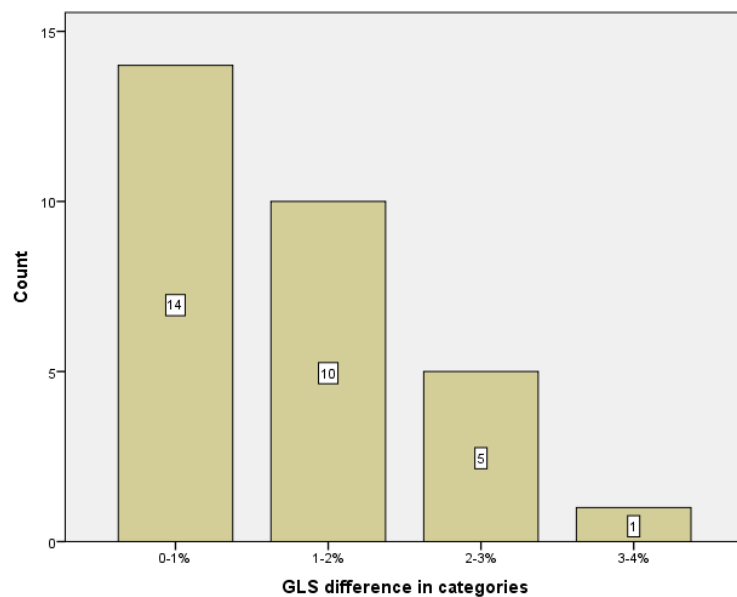


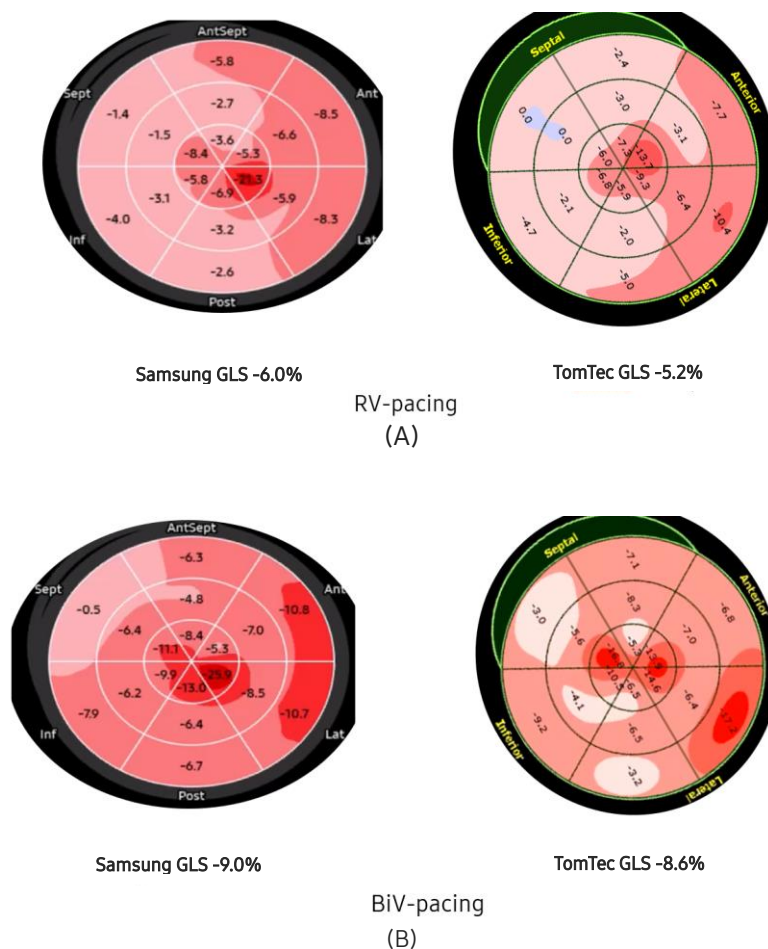
Figure 5. GLS difference in categories

## Case examples

### Case 1 – Right ventricular and biventricular pacing in comparison

- Male, 75 Years
- Implantation of a 2-chamber antibradycardia system in early 2024 for Sinus Node Dysfunction (SND) and little anticipated ventricular pacing
- During the subsequent year clinical picture changed:
  - Persistent AF
  - Increased ventricular pacing
  - Previously normal LVEF deteriorated to < 35%
- CRT-P upgrade 01/25
- During the first PM-check 02/25: Echocardiogram available during switch-off and switch-on of the LV-lead

In this case, GLS for Samsung was -6.0% compared to -5.2% of TomTec for RV-Pacing as shown in Figure 6. In case of Biventricular pacing, GLS were -9.0% and -8.6% for Samsung and TomTec, respectively. Both software programs represent each other well for strain imaging.



**Figure 6.** Bull's eye for (A) RV pacing (B) Biventricular pacing

*Note: The TomTec Bull's Eye is rotated 45% clockwise to align with Samsung*

### Case 2 – Cardiac amyloidosis

- Female, 62 Years
- Increasing fatigue, less performance
- No diagnosis after initial medical check-up
- Suspicion of Cardiac Amyloidosis in transthoracic echocardiogram
- Extensive workup then revealed Multiple myeloma and Cardiac AL-amyloidosis

GLS values were -10% and -9.8% for Samsung and TomTec in this cardiac amyloidosis patient, as illustrated in Figure 7.

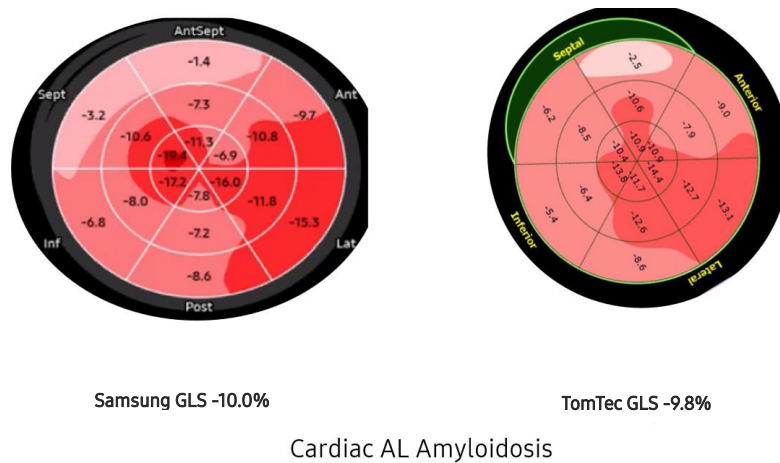


Figure 7. Bull's eye for Cardiac Amyloidosis

### Case 3 – Acute Myocarditis

- Male, 51 Years
- Presentation with fatigue, shortness of breath, and ectopies
- Coronary angiography: exclusion of CAD
- Cardiac MRI: myocarditis

In this case of acute myocarditis, mean GLS values were -14.5% for Samsung compared to -12.9% for TomTec, as shown in Figure 8.

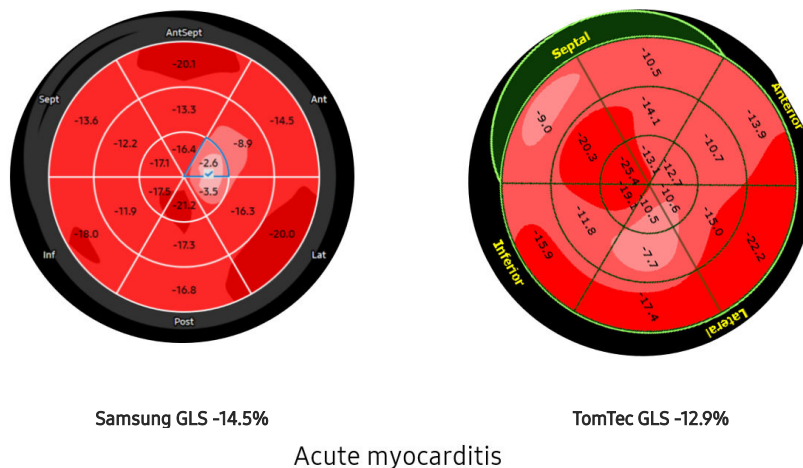


Figure 8. Bull's eye for Acute Myocarditis

## Conclusion

In this single center, retrospective quality control study, the agreement between Samsung Strain+ for LV and Tomtec was good within clinical acceptable limits. The overall mean difference between GLS measurements was <1%.

## References

- [1] Smiseth OA, Rider O, Cvijic M, Valkovič L, Remme EW, Voigt J-U. Myocardial Strain Imaging: Theory, Current Practice, and the Future. *JACC Cardiovasc Imaging* 2024;18. <https://doi.org/10.1016/J.JCMG.2024.07.011>.
- [2] Pagourelas ED, Mirea O, Duchenne J, Van Cleemput J, Delforge M, Bogaert J, et al. Echo Parameters for Differential Diagnosis in Cardiac Amyloidosis: A Head-to-Head Comparison of Deformation and Nondeformation Parameters. *Circ Cardiovasc Imaging* 2017;10. <https://doi.org/10.1161/CIRCIMAGING.116.005588>.
- [3] Lyon AR, López-Fernández T, Couch LS, Asteggiano R, Aznar MC, Bergler-Klei J, et al. 2022 ESC Guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS). *Eur Heart J* 2022;43:4229–361. <https://doi.org/10.1093/eurheartj/ehac244>.
- [4] Nagata Y, Takeuchi M, Mizukoshi K, Wu VCC, Lin FC, Negishi K, et al. Intervendor variability of two-dimensional strain using vendor-specific and vendor-independent software. *Journal of the American Society of Echocardiography* 2015;28:630–41. <https://doi.org/10.1016/j.echo.2015.01.021>.
- [5] Perez-Fernandez OM, Medina HM, Lopez M, Barrera M, Martinez A, Benavides J, et al. Global longitudinal strain in heart transplantation recipients using different vendors: reliability and validity in a tertiary hospital in Colombia. *International Journal of Cardiovascular Imaging* 2022;38:279–87. <https://doi.org/10.1007/S10554-021-02398-7>.
- [6] Excellence in digital healthcare n.d. <https://www.tomtec.de/excellence-in-digital-healthcare> (accessed May 4, 2025).

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