

1 Background

Microvascular damage as assessed by nailfold capillaroscopy is one of the best evaluable predictors of development and progression in systemic sclerosis (SSc). The modified Rodnan skin score (mRSS) is currently the gold standard to evaluate the extent and severity of skin involvement in SSc. However, this method lacks sensitivity to slight alterations in skin thickness, and is entailed by interobserver variability of 25%.

Recent studies have suggested that shear-wave elastography, namely Virtual Touch Imaging and Quantification (VTIQ), may increase the sensitivity and validity of skin involvement evaluation in SSc.

The purpose of this study was to explore possible associations between finger skin stiffness and different patterns of nailfold capillaroscopy and history of digital ulcers (DUs) in SSc patients.

2 Patients and Methods

Twenty-six SSc patients with confirmed SSc (ACR/EULAR 2013 criteria) were enrolled (23 female and 3 male, mean age 55.3±12.1 SD years) 13 limited SSc, 13 diffuse SSc; 23 were female;

Seventeen age- and gender-matched healthy controls; 14 were female (mean age 54.3±14.8 SD years)

- Nailfold capillaroscopy was performed in each patient and the results classified into the three validated patterns: *early*, *active*, and *late*.
- mRSS of the third finger was performed by one trained examiner on the middle phalanx, bilaterally.
- VTIQ was performed to evaluate absolute skin stiffness in both patients and controls on the same Rodnan sites, using an ACUSON S3000 (Siemens), ultrasound system.

Statistical analysis

The significance of differences between groups was calculated with Mann-Whitney test or Kruskal-Wallis test, as appropriate with p values <0.05 considered statistically significant.

Table 1 Clinical finding in 26 SSc patients.

| | Digital ulcers | | Differences between the groups (p value) |
|---------------------------|----------------|-------------|--|
| | Yes (n=11) | No (n=15) | |
| Age (years) | 52.6 (11.4) | 57.3 (12.6) | NS |
| RP duration (years) | 16.9 (10.2) | 13.3 (8.8) | NS |
| SSc duration (years) | 14.1 (9.3) | 11.3 (8.3) | NS |
| mRSS, at the left finger | 2.4 (0.8) | 1.3 (1.3) | NS |
| mRSS, at the right finger | 2.4 (0.8) | 1.4 (0.8) | NS |
| SWV, at the right finger | 5.3 (2.6) | 3.4 (1.5) | 0.027 |
| SWV, at the left finger | 5.4 (2.2) | 3.6 (1.7) | 0.025 |

- Skin was statistically significantly stiffer at the level of the dorsum of the middle phalanx of the third right finger (p=0.027) and left finger (p=0.025), in the group with DUs (table 1).

Table 2 Shear-wave velocity values (m/s) according to nailfold capillaroscopy pattern in 26 SSc patients.

| | Early, n=4 | Active, n=6 | Late, n=9 | Nonspecific, n=7 | Differences between the groups (p value) |
|--------------------------|------------|-------------|-----------|------------------|--|
| SWV, at the right finger | 3.7 (0.8) | 3.1 (0.9) | 3.7 (2.0) | 6.0 (3.0) | NS |
| SWV, at the left finger | 4.0 (1.7) | 3.0 (1.0) | 4.2 (2.2) | 5.9 (2.4) | NS |

SWV, shear-wave velocity in m/s. Results are shown in mean (SD).

- No differences in finger absolute skin stiffness were found in association with the different capillaroscopy patterns (table 2).

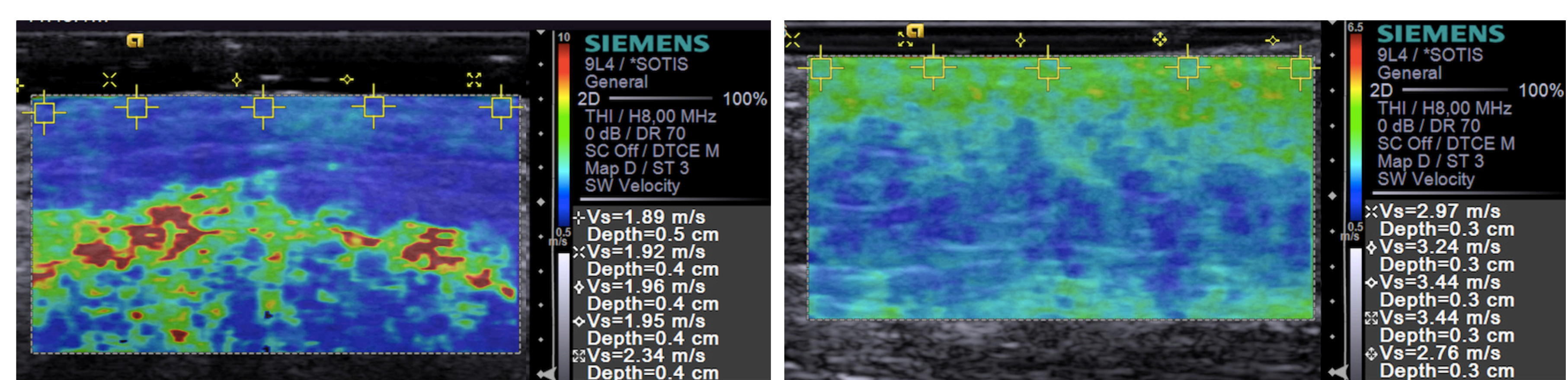


Figure 1 VTIQ of the dorsal aspect of the finger. Absolute shear-wave velocities (in m/s) within the sample gate (yellow box) are shown quantitatively on the right side. The colour scale depicts graphically the absolute stiffness of all tissues within the region of interest. (red=hard tissue; and blue=soft tissue).

4 Discussion

Our results indicate that patients with DUs have higher absolute skin absolute values, when evaluated by shear-wave elastography VTIQ, reaching statistical significance in the fingers.

Possible implications:

- Skin absolute stiffness may be correlated with severity of vascular involvement in SSc patients
- The identification of absolute skin stiffness may allow the detection of a subset of patients who might be prone to sever vascular involvement, thus identifying candidates for preventive therapeutic strategies
- This may have important clinical implications, and this non-invasive method may be used to identify high-risk patients who should undergo more careful evaluation.

Further explorations are therefore needed to assess shear-wave elastography as marker of vascular involvement in SSc patients.

5 Conclusions

- Absolute skin stiffness measured by VTIQ may improve the objective evaluation of skin involvement in SSc patients.
- VTIQ may add a new dimension to the assessment of DUs.
- Further studies are warranted to validate and refine this non-invasive method to evaluate skin involvement in SSc clinical practice.