

CHANGES IN THE THICKNESS AND STIFFNESS OF PALMO-PLANTAR SOFT TISSUES IN PEOPLE WITH SYSTEMIC SCLEROSIS

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1 Background

Systemic sclerosis (SSc) is a multi-system disease manifesting with both visceral and cutaneous fibrosis. Dermal elasticity is reduced and stiffness increased due to excessive dermal and subcutaneous deposition of collagen leading to increased skin thickness as well as hardening and tightening of the skin. Skin thickening in SSc has been demonstrated previously in ultrasound studies, although palmo-plantar soft tissues have not been evaluated yet.

The purpose of this study was to compare thickness and relative stiffness of palmo-plantar soft tissues between people with SSc and healthy controls (HC).

2 Methods

The study sample was composed of 25 SSc patients (23F and 2 M, mean age of 56.6±9.9years) with a a mean disease duration of 11.1±7.0 years and 18 HC (16F and 2M, mean age of 51.9±10.6 years)

➤ **Soft tissue thickness** was measured by high-frequency ultrasound using the LOGIQ 9 (GE, Healthcare) ultrasound system (Figure 1)

➤ **Relative soft tissue stiffness** was measured by compression-elastography using the LOGIQ 9 (GE, Healthcare) ultrasound system with the proprietary Elasto Q-Mode™ (Figure 2)

Measurements sites:

➤ Third metacarpophalangeal joint (3rd MCPJ),third metatarsophalangeal joint (3rd MTPJ), heel

Table 1 Soft tissue thickness (right) and relative stiffness (left) in patients with SSc and controls, mean (95% CI).

	Controls (n=18)	Systemic Sclerosis (n=25)	p-value for difference
Skin (3 rd MCPJ)	0.11 (0.10 to 0.12)	0.15 (0.13 to 0.16)	0.001*
Skin (3 rd MTPJ)	0.17(0.14 to 0.19)	0.16 (0.14 to 0.18)	0.497
Skin (Heel)	0.2 (0.17 to 0.24)	0.2 (0.17 to 0.23)	0.854
Fibro- fat pad (3 rd MCPJ)	0.27(0.30 to 0.37)	0.38 (0.34 to 0.40)	0.822
Fat-pad (3 rd MTPJ)	0.52 (0.44 to 0.59)	0.41 (0.35 to 0.47)	0.023
Fibro-fat pad (Heel)	1.11 (0.99 to 1.22)	0.95 (0.8 to 1.09)	0.100
Tendon (3 rd MCPJ)	0.34 (0.3 to 0.37)	0.38 (0.34 to 0.40)	0.145
Tendon (3 rd MTPJ)	0.22 (0.18 to 0.25)	0.21 (0.19 to 0.23)	0.95

	Controls (n=18)	Systemic Sclerosis (n=25)	p-value for difference
Skin (3 rd MCPJ)	0.8 (0.7 to 1.0)	1.5 (1.2 to 1.9)	0.001*
Skin (3 rd MTPJ)	1.9 (1.3 to 2.5)	1.5 (1.0 to 1.9)	0.964
Skin (Heel)	4.3 (3.8 to 4.8)	4.2 (3.8 to 4.6)	0.911
Fibro-fat pad (3 rd MCPJ)	0.5 (0.4 to 0.6)	0.7 (0.6 to 0.9)	0.003*
Fibro-fat pad (3 rd MTPJ)	0.5 (0.4 to 0.6)	0.8 (0.5 to 0.9)	0.082
Fibro-fat pad (Heel)	0.5 (0.4 to 0.6)	0.9 (0.7 to 1.1)	0.013*
Tendon (3 rd MCPJ)	3.9 (3.2 to 4.6)	3.7 (3.1 to 4.3)	0.913
Tendon (3 rd MTPJ)	1.8 (1.3 to 2.4)	2.7 (2.0 to 3.4)	0.035*

- The combined soft tissue thickness at the palmar and plantar sites were similar for the SSc group vs. control group, except for:
- Palmar skin over the 3rdMCPJ was thicker (p=0.001) in the SSc group
 - Fibro-fat pad in the plantar surface of 3rdMTPJ was thinner in the SSc group (p=0.023)
- Greater tissue stiffness values in SSc patients vs. controls.
- Palmar skin relative stiffness over 3rdMCPJ was greater in SSc vs. control
- Fibro-fat pad relative stiffness over the 3rdMCP and heel was significantly greater in SSc group vs. controls
- Tendon relative stiffness over the 3rdMTPJ was greater in SSc group vs. controls.

Soft tissue thickness

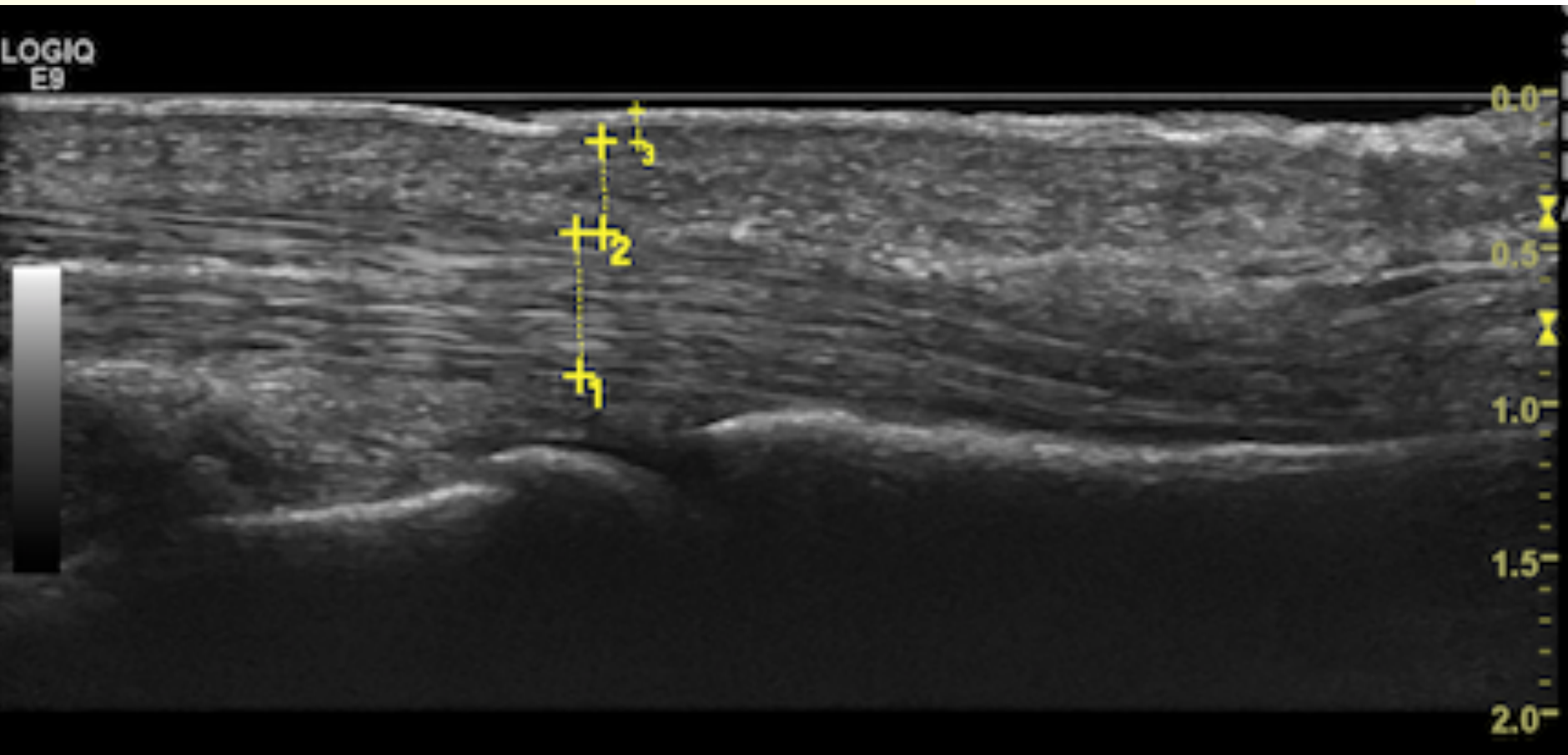


Figure 1 Longitudinal scan of the palmar aspect of 3rd MTP joint using B-mode. (1) Skin; (2) Fibro-fat pad; (3) Tendon.

Soft tissue stiffness

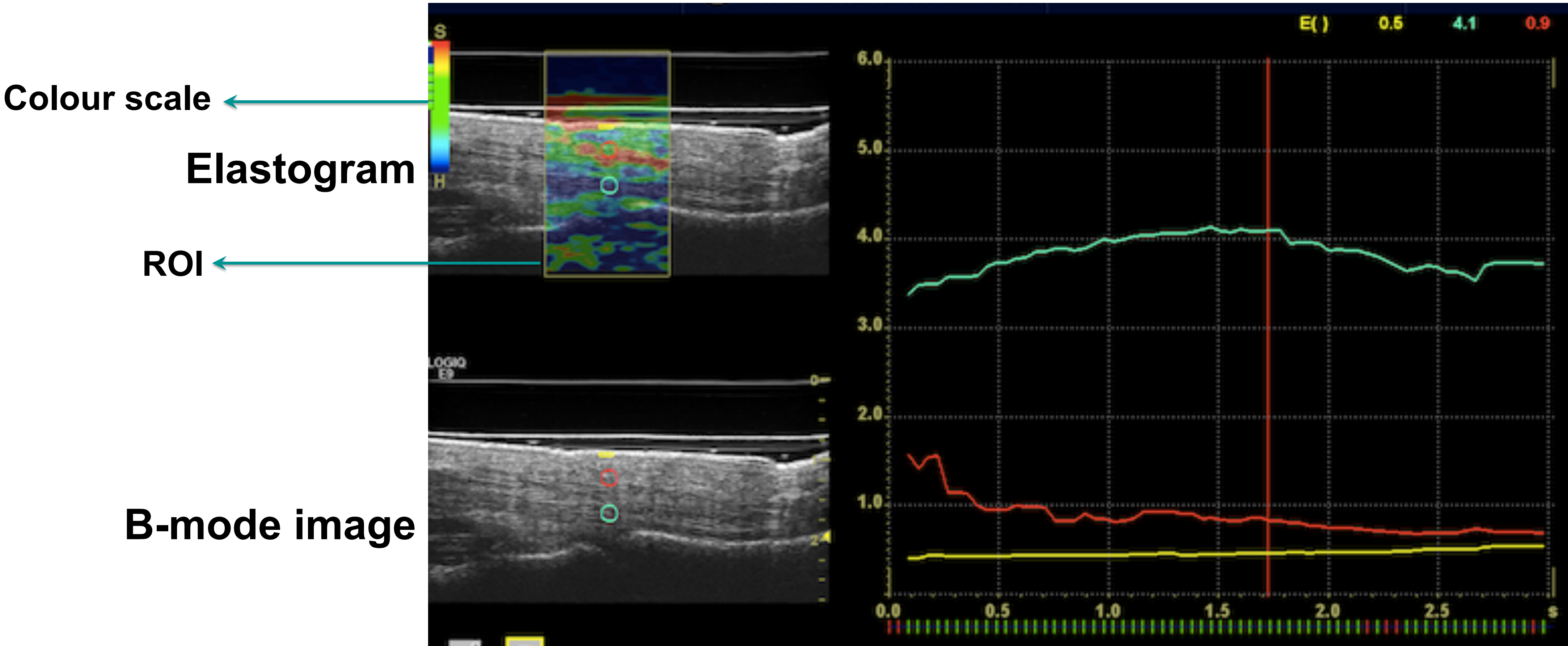


Figure 2 Longitudinal scan of the palmar aspect of third MTP joint using compression-elastography. Colour scale indicates the relative stiffness of the tissue within the region of interest (ROI). Red=soft tissue and Blue=hard tissue.

4 Discussion

This is the first study reporting soft tissue damage and biomechanical changes in people with SSc using compression-elastography.

Possible implications:

- Novel information about the changes in biomechanical properties of the palmar and plantar soft tissue stiffness occurring in patients with SSc
- The altered biomechanical properties in plantar soft tissues may result in reduced ability to dissipate pressure over the plantar area, resulting in increased discomfort or increased risk of development of foot ulcers in patients with SSc.

Further studies are needed to determine the relationship between soft tissue stiffness, pain and plantar pressures in people with SSc.

5 Conclusions

- a) Measurements of soft tissue relative stiffness by compression-elastography add a new dimension to the clinical assessment of soft tissue in SSc.
- b) Changes in thickness and stiffness of palmo-plantar soft tissues may lead to functional limitations of the hands and feet, as well as a decrease in shock attenuation properties and the inability to distribute foot-ground contact load affecting the foot during walking.