Developing a quantitative tool to evaluate dermal fibrosis in systemic sclerosis patients: a case-control study

Sirs,

Systemic sclerosis (SSc) is an autoimmune compound multisystem condition with het- erogeneous clinical manifestations (1-5). The skin thickening or fibrosis associated with SSc is generated by the formation of intercellular matrix in the dermis layer of the skin, by the accumulation of collagen, and by the affiliated oedema, owing to inflamma- tion and microvascular damage (1-5).

Currently the modified Rodnan Skin Score (mRSS) is the accepted measure by which we assess the extent of SSc skin fibrosis (6). The mRSS score assesses the thickness of skin, which is significant in the evaluation of SSc, but hardness and firmness of the skin are two separate characteristics, with apossible high impact in SSc disease's merit quantification and process (1-5). In addi- tion, with the possible use of "more intel- ligent technology" machines, subjectiv- ity will lessen and reliability will rise. The purpose of mRSS is to assess skin thickness and not other skin changes of the patient, such as tethering and hardness. Hence, we aimed to investigate alternative methods for assessing skin fibrosis in SSc patients.

Durometry is a painless, non-invasive, meth- od to assess skin hardness. Skin thickness, elasticity, density and oedema can affect skin hardness. Moreover, it offers a wider range of values for the evaluation of skin disease, as mRSS limits the scoring to only four differ- ent options. The broadened range, as well as the scaling, can make the assessment more precise as minor or moderate skin changes will be detected. Added to that, there is less variation of the durometry results measured by different investigators, thus making the assessment more objective (6).

Cutometry measures the skin's viscoelastic properties, by using the suction method. It is a non-invasive method appropriate for quantitative and objective evaluation of skin alterations, owing to SSc. The esca- lated skin viscoelasticity could be proposed as a new indication for the very early diag- nosis of SSc (7), so cutometry could be an additional tool to the mRSS. Besides that, inter-observer intra-class correlation is sig- nificantly higher for cutometry rather than for the mRSS (8).

The goal of this preliminary study was to investigate the validity and reliability of durometry and cutometry in the discrimi- nation of patients from healthy population, serving as diagnostic and prognostic tools in the assessment of SSc. The study com- prised of twenty female healthy controls (48.3±12.2 years) and twenty female pa- tients (53.5±12.8 years). All patients had diffuse scleroderma with an average dura- tion of 5 years (range 3–7).

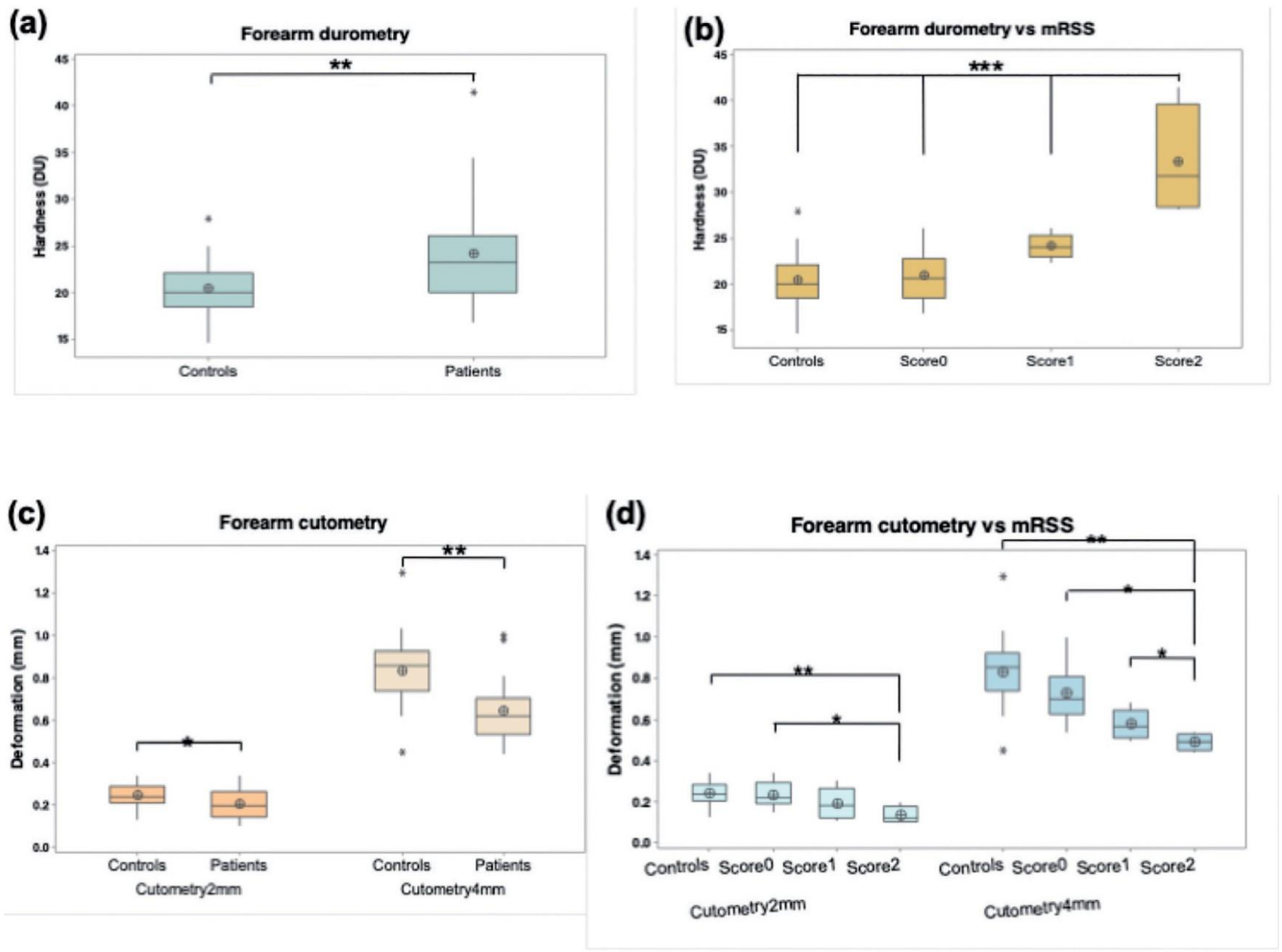

Fig. 1. Box-and-whisker plot (box: interquantile range, $^{+}$: mean;

: median; *: $p \leq 0.05$; **: $p \leq 0.01$; ***: $p \leq 0.001$), depicting: (**a**) statistical significant difference in forearm hardness ($p=0.0015$) between controls and patients; (**b**) remarkable correlation of durometry and mRSS for patients with moderate fibrosis, discriminating them from the controls, and from the patients with mild or no fibrosis ($p<0.001$); (**c**) statistical significant difference in forearm firmness between controls and patients, using cutometry's 2mm probe ($p=0.049$) and 4mm probe ($p=0.01$); (**d**) notable correlation of cutometry and mRSS for patients with moderate fibrosis; the 2mm probe discriminated them from the controls ($p=0.007$) and from the patients without fibrotic activity ($p=0.029$); the 4mm probe discriminated the moderately thickened patients from the controls ($p=0.002$), from the patients with mild fibrosis ($p=0.013$), and from the patients without fibrotic activity ($p=0.026$).

The forearm site was selected as it a region evaluated in the literature for drug testing, easily accessible and would not causing any irritation to the patient. Durometry meas- urements were made at predetermined land- mark sites in the dorsal sites of the forearms, in the middle line and with a distance of 6 cm from the elbow crease. For cutometry measurements, the diameter of the probe that was used, 2 mm and 4 mm, refers to the aperture diameter of each probe, that the negative pressure is applied to the skin.

The results implement accuracy of durom- etry and cutometry to identify SSc patients. In terms of hardness, the results of this study suggest that there is a significant difference between the controls and the patients (mean value 20.42 *versus* 24.18, and $p=0.015$) (Fig. 1a). In terms of deformation, that represents skin firmness, the results suggest a signifi- cant difference between the controls and the patients, in regards to the 2 mm probe ($p=0.049$), and to the 4mm one ($p=0.01$). In terms of hardness, the results of this study suggest that the correlation between durom- etry and mRSS score is significant as the mean for the moderately thickened patients (score 2) was widely discriminated from the rest categories (Fig. 1b). In terms of defor- mation, that is representative of skin firm- ness, the results suggest that the correlation between the cutometry (using the 2 mm and the 4 mm probe) and mRSS was significant as the mean for moderately thickened patients (score 2) was extensively differenti- ated from the controls and the uninvolved patients. It is important to highlight that the durometry and cutometry were able to distinguish between severity of fibrosis in this cohort of patients (Fig. 1b and d). Fur- ther work will understand the role of these non-invasive techniques in the detection of early scleroderma and monitoring disease progression a large cohort of patients. To conclude, quantitative assessment tools are reliable for monitoring the severity of skin fibrosis in patients with SSc.

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