

Efficacy of connective tissue massage and Mc Mennell joint manipulation in the rehabilitative treatment of the hands in systemic sclerosis

Susanna Maddali Bongi · Angela Del Rosso · Felice Galluccio · Fabrizio Sigismondi · Irene Miniati · M. Letizia Conforti · Francesca Nacci · Marco Matucci Cerinic

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Abstract Rehabilitation may contribute to the management of systemic sclerosis (SSc) dealing with disabilities due to hand involvement. The aim of this study is to evaluate the efficacy of a rehabilitation programme based on the combination of connective tissue massage and Mc Mennell joint manipulation specifically conceived for SSc patients' hands. Forty SSc patients were enrolled: 20 (interventional group) were treated for a 9-week period (twice a week, 1 h per session) with a combination of connective tissue massage, Mc Mennell joint manipulation and home exercise programme, and 20 (control group) were assigned only to home exercise programme. Patients of both groups were assessed at baseline (T0), after 9 week (T1) and at a 9 weeks follow-up (T2). They were evaluated for quality of life by SF-36 and Health Assessment Questionnaire (HAQ), hands involvement by Hand Mobility in Scleroderma (HAMIS) test, Cochin hand functional disability scale and the measurements of ROM. In the interventional group, fist closure, HAMIS test and Cochin hand functional disability scale improved at the end of the treatment ($p < 0.0001$) as

well as HAQ, Physical Synthetic Index (PSI) and Mental Synthetic Index (MSI) of SF-36 scores (HAQ and PSI, $p < 0.0001$; MSI, $p < 0.001$). In the control group, the programme of home daily exercises improved only fist closure at the end of the treatment ($p < 0.0001$). The combination of connective tissue massage, Mc Mennell joint manipulation and home exercise programme is effective in the rehabilitative treatment of SSc hands. This combined treatment may lead to an improvement of hand function and quality of life.

Keywords Connective tissue massage · Hand · Mc Mennell · Physiotherapy · Rehabilitation · Systemic sclerosis

Introduction

Systemic sclerosis (SSc) is characterised by skin induration, internal organ damage and musculoskeletal involvement. Hands are involved in most patients with SSc due to the thickening of the skin, which can result in contractures of the fingers and result in a claw-type deformity, with metacarpophalangeal (MCP) extension, interphalangeal flexion and thumb adduction [1–5]. Finger flexion and extension are the most impaired aspects of hand mobility in patients with SSc [6]. Loss of hand ability may be one of the main factors that influence the activities of daily living of patients with SSc [7]. Typically, the hand deformation and the limitations of movement of the fingers are always almost due to the skin thickening, like fibrosis and edema, and to the involvement of peri-articular structures [8].

The involvement of joints and peri-articular tissues is present in 46–97% of SSc patients, representing the onset manifestation in 12–65% [9–11].

S. Maddali Bongi · A. Del Rosso · F. Galluccio · I. Miniati ·
M. L. Conforti · F. Nacci · M. Matucci Cerinic
Department of Biomedicine, Division of Rheumatology, AOUC,
Denote Centre, University of Florence,
Florence, Italy

F. Sigismondi
Associazione Multidisciplinare Riabilitazione Reumatologica
(AMuRR), Blue Clinic Rheumatic Rehabilitation Center,
Florence, Italy

M. Matucci Cerinic (✉)
Department of Biomedicine, Division of Rheumatology,
Villa Monna Tessa, Viale Pieraccini 18,
50139 Florence, Italy
e-mail: cerinic@unifi.it

Less frequently, patients are affected with arthritis, which may have an oligo-polyarticular pattern with acute or sub-acute involvement and an intermittent or chronic remitting course [12, 13]. Pharmacological treatment may be helpful when a synovitis or an arthritis is present, while a specific rehabilitation programme can prevent and/or reduce disabilities due to skin and peri-articular fibrosis. However, in literature, only few studies on SSc patients are available [6–8, 15]. A previous preliminary study in a limited group of patient suggested that a combined rehabilitative treatment was efficacious for hand involvement [6].

The aim of this study was to evaluate the efficacy of a combined rehabilitation programme based on connective tissue massage, Mc Mennell joint manipulation and home exercises compared to an home daily exercise programme only.

Materials and methods

Forty Caucasian SSc patients (ten men and 30 women; age, 57.8 ± 11.8 years; disease duration, 9.0 ± 3.8 years) [15] were consecutively enrolled from the outpatient clinic of the Department of Biomedicine, Division of Rheumatology of the University of Florence and agreed by a written informed consent to participate in the study. All patients underwent a clinical examination and were assessed according to international guidelines [16].

No patient was suffering from arthritis (absence of joint swelling and tenderness, negative X-ray and ultrasonography) or myositis (negative muscle enzymes and electromyography). All patients presented stiffness and loss of joint function due to flexion contractures, caused by skin retraction. Eighteen patients had also fingertips ulcers. Sixteen patients presented lung involvement (interstitial lung disease and/or pulmonary hypertension). None of the patients previously performed rehabilitation at hands and upper limbs.

At enrolment, all patients were provided with educational recommendations on general measures (nutrition, skin warming and skin and mucosal protection) and medical information on SSc.

Patients were assigned to two groups by a random number sequence prepared by a blinded rheumatologist. The rehabilitative treatment was performed by all patients in the same period of the year. Patients in combined treatment performed a rehabilitation programme with the combination of connective tissue massage, Mc Mennell joint manipulation and home exercises. In control group, patients performed only a home daily exercise programme for the hands.

In both groups, all patients continued their pharmacological treatments (alprostadil- α -cyclodextran, calcium

channel blockers, topical glyceryl trinitrate, proton pump inhibitors, clobopride, steroids, cyclophosphamide, azathioprine, D-penicillamine and methotrexate) with no changes throughout the study.

Rehabilitation programmes and techniques

Patients in interventional group received a combined rehabilitative treatment of connective tissue massage and Mc Mennell joint manipulation for 9 weeks, twice a week, 1 h per session and home daily exercises. Control group performed only the home daily programme.

Connective tissue massage is a manual technique used to treat altered connective tissues in order to modify local bloodstream and detach involved tissue by connective tissue stretching [17–19]. After a brief examination of both upper limbs to control the presence of Raynaud phenomenon and ulcers, the treatment starts with the massage of forearm (Fig. 1a–c) and hand (Fig. 1d) lasting about 10 min per limb. If necessary, after Mc Mennell manipulations, other 5 min of massage can be performed.

Mc Mennell joint manipulation is a technique aiming to recover the “joint play”, i.e. the involuntary, subtle range of motion that normal joints display on multiple planes, necessary for normal voluntary joint mobility. It improves articular movement, reduces pain and stretches articular capsulae and ligaments [20]. Treatment starts with wrist manipulations on frontal and radial side diastasis (Fig. 2a, b) and continues with the manipulations of the MCP (Fig. 2c, d) and finally of the interphalangeal joints (Fig. 2e, f) lasting 15 min per side.

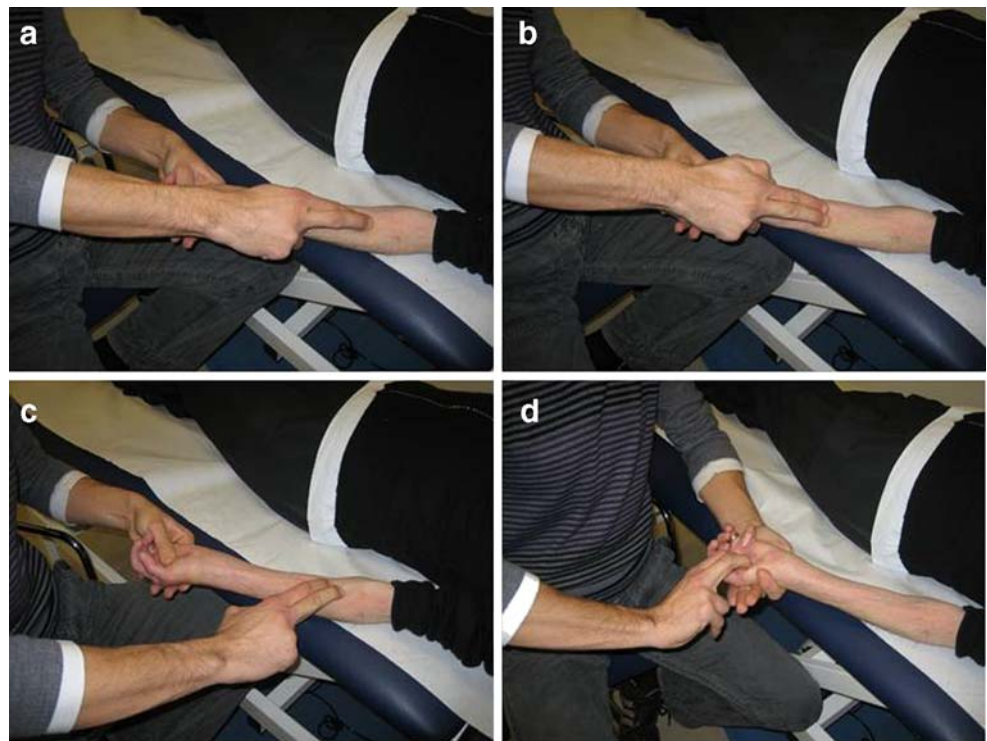
Programme of home daily exercises Patients have one session/day (lasting 20 min) of active exercises for the hand, consisting in movements of the fingers and fine movements of the hand like flexion and extension of the single fingers, adduction and abduction of the fingers (Fig. 3h, i), terminal and subterminal pinches with all fingers in opposition to thumb (Fig. 3f, g), movements of flexion, extension, ulnar and radial deviation of the wrist (Fig. 3b–e) and pronation and supination of the forearms.

Assessment

SSc patients in both groups were assessed at baseline (T0), at the end of the 9-week rehabilitation period (T1) and after 9 weeks of follow-up (T2) by the same therapist (FS).

Quality of life assessment The Italian version of the Medical Outcomes Survey Short Form (SF-36) [only the

Fig. 1 Connective tissue massage of the forearm (a–c) and of the hand (d)



Physical Synthetic Index (PSI) and the Mental Synthetic Index (MSI) [21] and the Italian version of HAQ [22] were used to assess the quality of life (QoL).

Hand assessment The Hand Mobility in Scleroderma (HAMIS) test [23], the Cochin hand functional disability scale [24] and the measurements of range of motion of hand opening and fist closing expressed in centimetres were used to assess hand function.

Statistical analysis

Data are presented as mean ± standard deviation (median, range) and as numbers and percentages. To compare the groups for clinical characteristics, chi-square test and Student's *t* test were performed for binomial variables and for continuous variables, respectively.

For all outcome measures, analysis of variance for repeated measures (with post-hoc Bonferroni test) was used

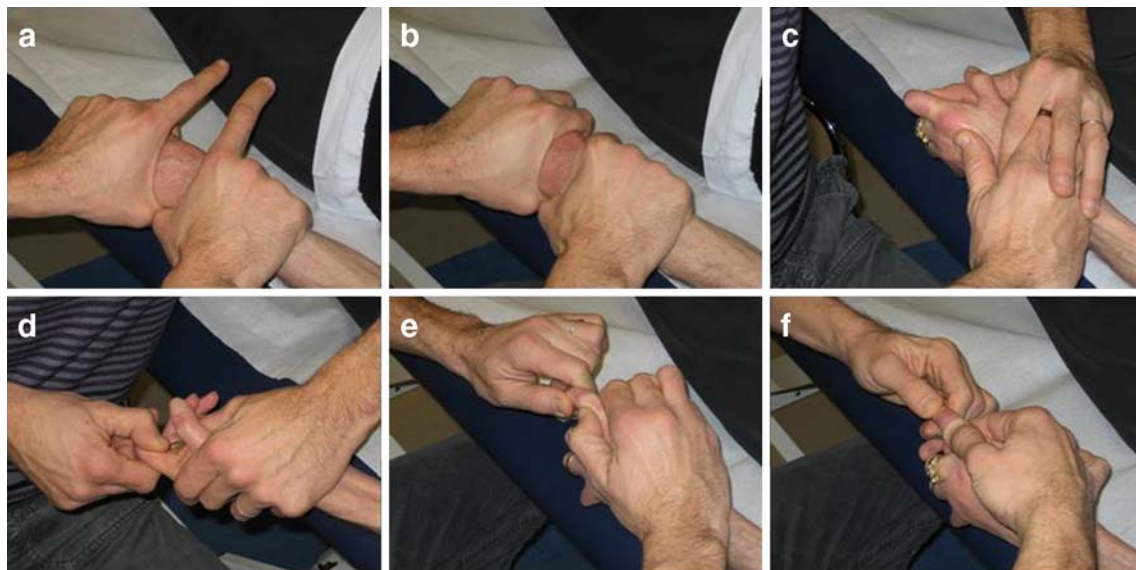


Fig. 2 Mc Mennell: wrist manipulations on frontal and radial side diastasis (a, b), manipulations of the MCP joints (c, d) and of the interphalangeal joints (e, f)

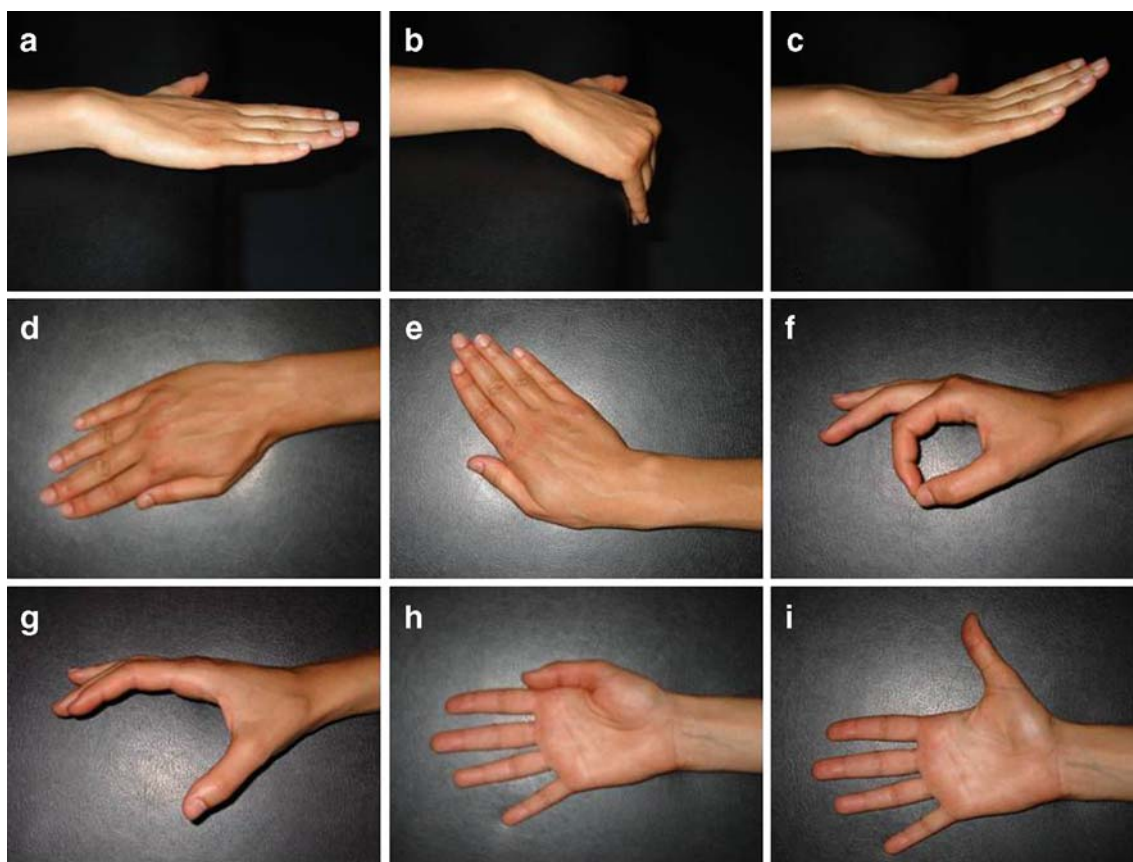


Fig. 3 Set of home programme exercise. Start position (a), movements of flexion (b), extension (c), radial and ulnar deviation of the wrist (d, e), terminal and subterminal pinches with all fingers in opposition to thumb (f, g), adduction and abduction of the fingers (h, i)

to detect short-term (between T0 and T1) and long-term (between T0 and T2) changes in both group. Data analysis was performed using the SPSS statistical package 12.0 for Windows. Significance was set at $p < 0.05$.

Clinical trial registration

The study was registered with Current Controlled Trials (<http://www.controlled-trials.com>) no. ISRCTN36648909.

Results

In both groups, SSc patients were not different in their baseline characteristics (Table 1). None of the patients dropped out from the study.

In the combination treatment group, fist closure, HAMIS test and Cochin hand functional disability scale improved significantly ($p < 0.0001$) at the end of the treatment and were maintained after 9 weeks of follow-up ($p < 0.0001$). Hand opening was not ameliorated by the treatment. HAQ ($p < 0.0001$), PSI ($p < 0.0001$) and MSI ($p < 0.001$) of SF-36 scores improved significantly at the end of the treatment,

but only the improvement of the HAQ was maintained at follow up ($p < 0.0001$).

In the control group, home daily exercises improved only fist closure at the end of the treatment ($p < 0.0001$). This effect was not maintained at follow-up. HAMIS test, Cochin hand functional disability scale and hand opening were not modified by home exercises. HAQ, PSI and MSI of SF-36 scores did not improve after the home programme (Table 2).

Discussion

Our data show that, in SSc, a combined rehabilitation approach is more effective (except for hand opening) than home-based exercises.

Hand involvement in SSc heavily influences daily living activities. Patients feel activities depending on hand and arm function as harder to perform than activities depending on lower limb function. Raynaud phenomenon, stiffness, grip force and dexterity were factors with the strongest associations with activities of daily living (ADL) difficulties. Furthermore, assistive devices and alternative working methods improved ADL ability [25].

Table 1 Clinical characteristics at baseline

| Clinical characteristic | Interventional group | Control group | <i>p</i> value |
|---|----------------------|---------------|----------------|
| Sex (F/M) | 16/4 | 14/6 | NS |
| Age | 56.4±10.2 | 58.1±13.4 | NS |
| Disease duration (years) | 8.7±3.5 | 9.4±4.2 | NS |
| Skin Score | 11.1±6.5 | 12.0±7.2 | NS |
| Active ulcers | 10 | 8 | NS |
| Raynaud | 20 | 20 | NS |
| Musculoskeletal involvement | 20 | 20 | NS |
| Gastrointestinal involvement | 13 | 14 | NS |
| Lung involvement | | | |
| ILD | 6 | 4 | NS |
| PAH | 2 | 4 | NS |
| Hands measures | | | |
| HAMIS Test | 11.40±6.57 | 10.75±4.59 | NS |
| Cochin hand functional disability scale | 33.05±24.89 | 31.80±18.81 | NS |
| Hand opening (cm) ^a | 15.60±1.09 | 15.34±1.30 | NS |
| Fist closure (cm) ^a | 2.24±1.60 | 2.20±1.07 | NS |
| Global health condition measures | | | |
| MSI (SF-36) | 37.26±5.55 | 39.06±5.31 | NS |
| PSI (SF-36) | 34.02±7.88 | 38.82±9.68 | NS |
| HAQ | 0.94±1.02 | 0.69±0.80 | NS |

^a Mean values between right and left hand

ILD interstitial lung disease, PAH pulmonary hypertension, MSI Mental Synthetic Index, HAQ Health Assessment Questionnaire

Thus, treatments aimed to improve hand function and ergonomic tools may be of outstanding importance to reduce the disability due to hand involvement in SSc [26].

Hand articular and peri-articular tissues are involved in the majority of SSc patients, with a wide range of clinical manifestations ranging from arthralgias and stiffness to arthritis [27] and tenosynovitis with tendon friction rubs [28] and to muscle manifestations, such as myalgias and

myositis [27]. These manifestations, although sometimes clinically important, are usually responsive, but often not completely, to medical therapy [27].

In SSc hand progressive sclerotic retraction of skin, subcutaneous tissues and tendon sheaths are frequent and lead to stiffness and loss of joint function [11, 13]. This manifestation is quite severe, related to disease progression and scarcely responsive to the common medical treatments

Table 2 Results at the end of the treatment (T1) and after the follow up (T2)

| | | T0 | T1 | T2 | OVERALL GROUP EFFECT | T0 vs T1 | T0 vs T2 |
|---|-------------|-------------|-------------|-------------|----------------------|----------|----------|
| HAMIS test | Combination | 11.40±6.58 | 7.00±6.77 | 7.80±6.38 | <0.0001 | <0.0001 | <0.0001 |
| | Control | 10.75±4.60 | 11.10±4.61 | 10.95±3.97 | NS | NS | NS |
| Cochin hand functional disability scale | Combination | 33.05±24.89 | 20.30±21.56 | 22.10±21.01 | <0.0001 | <0.0001 | <0.0001 |
| | Control | 31.80±18.81 | 32.50±18.40 | 33.25±17.97 | NS | NS | NS |
| Hand opening | Combination | 15.60±1.09 | 16.03±1.40 | 15.57±1.60 | NS | NS | NS |
| | Control | 15.34±1.30 | 15.18±1.28 | 15.29±1.55 | NS | NS | NS |
| First closure | Combination | 2.24±1.60 | 1.47±1.42 | 1.45±1.25 | <0.0001 | <0.0001 | <0.0001 |
| | Control | 2.20±1.08 | 1.19±1.00 | 2.19±1.09 | <0.0001 | <0.0001 | NS |
| MSI | Combination | 37.26±5.55 | 41.53±8.05 | 38.79±5.80 | 0.002 | <0.001 | NS |
| | Control | 39.06±5.31 | 38.75±7.09 | 39.60±6.40 | NS | NS | NS |
| PSI | Combination | 34.02±7.88 | 38.84±8.77 | 36.90±8.09 | <0.0001 | <0.0001 | NS |
| | Control | 38.82±9.68 | 36.73±9.33 | 34.83±7.40 | NS | NS | NS |
| HAQ | Combination | 0.94±1.02 | 0.57±0.79 | 0.55±0.81 | <0.0001 | <0.0001 | <0.0001 |
| | Control | 0.69±0.80 | 0.61±0.81 | 0.47±0.39 | NS | NS | NS |

MSI Mental Synthetic Index, PSI Physical Synthetic Index, HAQ Health Assessment Questionnaire

[26]. Flexion contractures, reduced hand extension and increased finger flexion are strongly correlated with high HAQ scores [29]. Thus, a rehabilitative approach for the hands of SSc patients may also be helpful in reducing the impact of hand impairment and QoL changes [14].

To deal with the different and severe problems related to SSc hand involvement, we have chosen a rehabilitation approach based on the combination between different techniques acting in a synergistic modality. In fact, connective tissue massage modifies local bloodstream and relaxes connective tissue by stretching [17–19], and Mc Mennell joint manipulation recovers the “joint play” (the involuntary, subtle range of motion normally displayed by joints on multiple planes), thus improving articular movement, reducing pain and stretching articular capsulae and ligaments [20].

Concurrently, these methods improve the microcirculation and detach skin and subcutaneous tissues maximising joint mobility by articular stretching and mobilisation. Auto-administered home daily exercises might maintain the results obtained by assisted rehabilitation.

At the best of our knowledge, this is the first study combining these techniques in a rehabilitation programme specifically conceived for the hands of SSc patients.

Our study clearly shows that the association between these techniques is more efficacious than a programme based only on daily home exercises in treating hand of SSc patients, whose contractures in flexion reduce range of motion, dexterity and ability, ultimately leading to impairment of QoL [29] and limitations in ADL [25].

At the end of the treatment period, our combined protocol increased the HAMIS test [23] and the Cochin hand functional disability scale [24]. The improvement was confirmed after a period of follow-up. These results demonstrate that, in SSc patients, our protocol improves mobility, fine movements, skilful tasks and hand functioning. The treatment increases fist closure, maintained also at follow-up. The results on hand opening were instead largely disappointing, without any amelioration by the treatment. The general health condition measures assessed in our study, mental and physical self-perceived QoL and HAQ significantly improved at the end of treatment in respect to base values. At follow-up, MSI and HAQ remained stable, while PSI lost the significance. SSc patients treated with home hand exercises improved only in fist closure at the end of the treatment.

We believe that the protocol should be maintained with a long-term self-management program of home-based exercises. In fact, the continuity of care is essential in the rehabilitation of patients affected with chronic rheumatic diseases, in order to maintain its efficacy [30]. In the chronic care model, patients are encouraged to become part of the health care team, and the concept of self-care or self-management plays a central role [31].

Some evidence exists about the effectiveness of self-management in SSc patients. Recently, Mugii et al. [32] studied the efficacy of self-administered stretching of each finger in SSc patients, showing that amelioration of range of motion was present in each finger after 1 month and maintained within 1 year. The combination of stretching exercises may be potentially useful in order to maintain the efficacy reached with a physiotherapist-guided program.

Our study has two main limitations. It is conducted on a relatively short period (18 weeks, divided in 9 weeks of treatment and nine of follow-up) and considers a relatively low number of SSc patients that did not allow us a disease subsetting.

In conclusion, the combination of Mc Mennell joint manipulation joint manipulation and connective tissue massage on top of a home exercise program may be effective in the rehabilitative treatment of SSc hands.

A study on a larger cohort of patients is warranted to determine the effect on single disease subsets and in different phases of the disease.

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Disclosures None.

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