Effects of manipulative treatment on surgical scars of the spine and abdomen measured with Adheremeter, thermal imaging camera and VAS scale

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Abstract - This pilot clinical study evaluates the effects of manipulative treatment on surgical scars. Forty patients were evaluated, 20 of whom had surgical scars on the spine, 20 with surgical scars on the abdomen. The scars were evaluated with a thermal imaging camera and Adheremeter. All patients received two treatments and completed a VAS (Visual Analogic Scale). The scar area may have a local temperature difference due to decreased vascularisation of the fibrotic tissue, with an alteration of locoregional tissue sensitivity and a nociceptive reflex. The aim of the study is to assess the extent to which manipulative treatment can alter the local tissue texture of the scar.

Key words: Surgical scars, manipulative treatment, adheremeter, thermoscan

Key message:
- Superficial surgical scars affect the underlying connective tissue and can induce pain and postural consequences even after years
- The manipulative treatment of scars, even after some time, induces tissue beneficial effects that can be objectively evaluated

Introduction

Communication of the fascial system takes place via mechanical transduction (1). The connective tissue sends forces through its fibrous weave that are translated into a mechanical signal (2).
A small, altered signal such as a scar, protracted over time, can affect an individual's posture. Treating a scar, even years later, normalises the fascial system which, influenced by continuous tension, albeit of low intensity, may be in a state of allostatic overload (3). Changes in tissue mobility that are perceived during palpation reflect local changes and can positively interfere with balance even at a distance, favouring the individual's overall fascial comfort (4,5).

Fig. 1 - Examples of scarring of the lumbar spine and cervical spine.

Purpose

Check whether the temporary increase in locoregional blood perfusion with peri-scar mobilisation and the associated increase in temperature, measured with a standard method, favours the response of the collagen tissue, promoting physiological recovery and preserved mobility.

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Materials and methods

Twenty patients with a neurosurgical scar located on the spine (group A) ***(Fig. 1)*** and 20 patients with a surgical scar on the abdomen (group B) ***(Fig. 2)*** were enrolled for the study.

Fig. 2 - Examples of abdominal scarring.

The following inclusion and exclusion criteria were followed for the enrolment of patients in the study:

- Inclusion criteria: eligible patients who presented a surgical scar 20 days after surgery, localised to the spine or abdomen.
- Exclusion criteria: patients with a traumatic scar located on the limbs, neck or chest; ongoing dermatological problems of an infectious nature; presence of stitches.

A technique known as 'fascial unwinding' was used (10-13) in which the operator, with light and continuous finger contact on the scar, follows the tension of the fascia and then induces small movements in the direction of greater mobility of the scar.

Each patient underwent two treatments with an interval of 10 to 15 days. In each treatment, the following procedures were carried out: reception of the patient and adaptation to the environment for 10 minutes at an air-conditioned temperature of 26 °C, administration of the VAS scale, test with the Adheremeter, pre-treatment camera photos, 10-minute treatment with fascial techniques, at the end of the treatment the patient was allowed to rest for 10 minutes at an air-conditioned temperature of 26 °C and finally photographed with a post-treatment camera.

Scars were assessed at each session before and after treatment by means of Adheremeter, thermal imaging camera and VAS scale.

Adheremeter

Adheremeter (6) is a validated instrument for the evaluation of skin scars and shows a numerical value referring to the degree and depth of scar adhesion. This rating scale is printed on a tracing sheet, placed over the scar and the skin is moved in the orthogonal directions drawn on the instrument ***(Fig. 3).*** The maximum possible score is 56 and corresponds to the mobility of the skin in each direction of space, while unilateral skin displacement has a maximum score of 14.

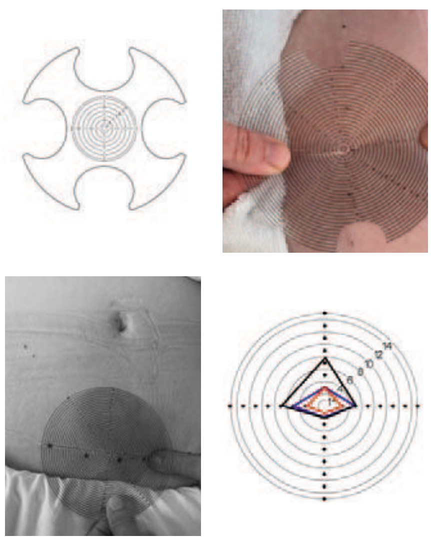


Fig. 3 - Adheremeter instrument and application

Termal imaging camera

The thermal imaging camera or thermographic camera is a special camera sensitive to infrared radiation and capable of obtaining thermographic images or footage ***(Fig. 4).*** From the radiation detected, maps of surface temperatures are obtained; infrared cameras for skin thermal imaging indicate reference values expressed in degrees centigrade. The machine shows us the temperature changes on a chromatic scale indicated by the colours blue and violet for cold surfaces, while hot surfaces are highlighted in red (7).

Fig. 4 - Instrument and thermal scale of the thermal imaging camera.

AS scale

The Visual Analogue Scale (8,9) ***(Fig. 5)*** corresponds to the visual representation of the extent of pain felt by the patient and consists of a predetermined line 10 cm long, where the left end corresponds to 'no pain' and equals a score of 0, and the right end to 'worst possible pain' and equals a score of 10. The patient is asked to draw a mark on the line representing the level of pain experienced. The scale line can be oriented horizontally or vertically, without affecting its sensitivity; however, studies have shown that the horizontal version has a lower failure rate. In other versions, the scale can be administered by means of a plastic-coated holder with a moving cursor to indicate the level of perceived pain; with a compilation time of less than one minute.

Pain intensity scale 1 to 10.

No Pain   Moderate Pain   Very Severe Pain

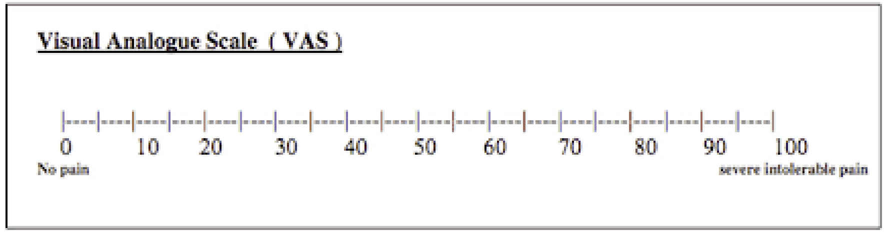


Fig. 5 - VAS scale.

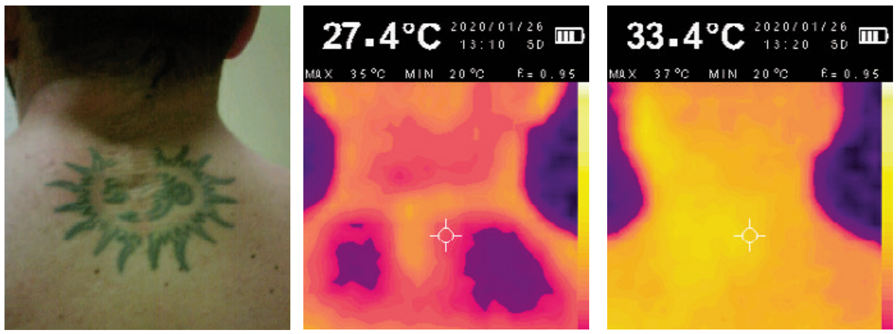
Results

In group A, the average of the pre-treatment thermal photo results (T0), expressed in degrees centigrade, is 31.3. The average of the post-treatment thermal photo results (T1), expressed in degrees centigrade, is 33.3.

The average difference in pre- and post-treatment temperature (DT) is 2 °C.

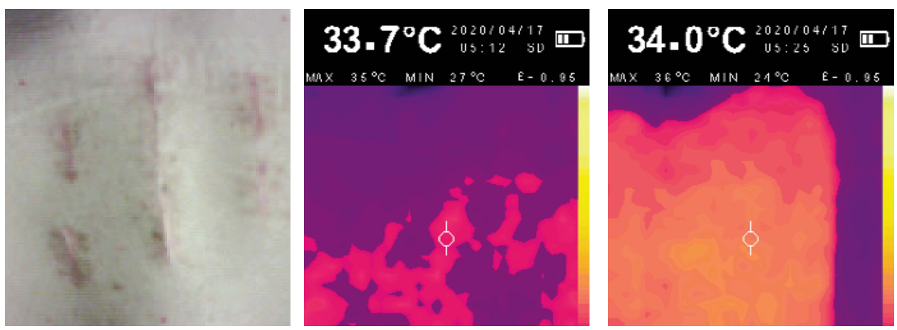
In the second session, the pre-treatment thermal photo results in (T2) show an average in degrees Celsius of 31.5° and a post-treatment average (T3) of 33.4°; for a post-treatment and pre-treatment temperature difference (DT) of 1.9°.

In Figures 6 and 7 in the pre-treatment photo, cold purple areas referable to poorly vascularised tissue can be seen; in the post-treatment photo, the thermal imaging camera detects homogeneous areas of increased vascularisation ***(Figures 6, 7).***



Picture of Scar | **Pre-treatment thermal imaging** | **Post-treatment thermal imaging**

Fig. 6 - Cervical spine scar (group A), photo taken by thermal imaging camera before and after treatment. Cervical spine scar from neoplastic excision C7-D1 (scar age 1 year).



Picture of Scar | **Pre-treatment thermal imaging** | **Post-treatment thermal imaging**

Fig. 7 - Lumbar spine scar (group A), photo taken by thermal imaging camera before and after treatment. Lumbar spine scar for stabilisation with L3-L4-L5 metal synthesis means (scar age 2 years).

In group B, the average of the pre-treatment thermal photo results (T0), expressed in degrees centigrade, is 3.5. The average of the post-treatment thermal photo results (T1), expressed in degrees centigrade, is 33.7.

The average difference in pre- and post-treatment temperature (DT) is 1.2 C°.

In the second session, the pre-treatment thermal photo results in (T2) show an average in degrees Celsius of 32.3° and a post-treatment average (T3) of 33.9°; for a post-treatment and pre-treatment temperature difference (DT) of 1.6°.

In Figures 8 and 9 in the pre-treatment

photo, the cold purple areas referable to poorly vascularised tissue can be seen; in the post-treatment photo, the thermal imaging camera detects homogeneous areas of increased vascularisation ***(Figures 8, 9).***

The results of the 40 subjects treated in the clinical study showed a significant difference in temperature increase expressed in degrees centigrade and a homogeneous distribution of temperature pre- and post-treatment. The second session did not show a significant maintenance of the temperature increase compared to the subjective starting temperature. Table 1 and Table 2 show, respectively, the results of the average temperatures expressed in degrees centigrade of group A ***(Tab. 1)*** and group B ***(Tab. 2)*** in T0-T1, in T2-T3 and the difference in temperature pre- and post-treatment (DT).

Tab. 1 - Temperature averages in degrees centigrade of group A in T0-T1, in T2-T3 and temperature difference pre- and post-treatment.

Group A T		
T0 Average	T1 Average	DT°
31.3	33.3	2
T2 Average	T3 Average	DT°
31.5	33.4	1.9

The results of the averages of the Adheremeter measurements prior (T0)

Tab. 2 - Temperature averages in degrees centigrade of group B in T0-T1, in T2-T3 and temperature difference pre- and post-treatment.

Group B T		
T0 Average	T1 Average	DT
32.1	34.6	2.5
T2 Average	T3 Average	DT°
32.3	33.9	1.6

to the treatments and the final measurements after the two treatment sessions (T2) and the scar mobility improvement score are reported.

In group A ***(Tab. 3),*** the results in T0 have a score of 10.5 and in T2 of 12.1; for a mobility improvement value of 1.6.

Tab. 3 - Group A averages in T0, T2 and improvement scores

Group A Adheremeter		
T0 Average	*T2 Average*	*Improvement Score*
10.5	12.1	1.6

In group B ***(Tab. 4),*** the results in T0 have a score of 24.7 and in T2 of 34.5; for a mobility improvement value of 9.7.

Tab. 4 - Group B averages in T0, T2 and improvement scores

Group B Adheremeter		
T0 Average	*T2 Average*	*Improvement Score*
24.7	34.5	9.7

Table 2 shows the results of the Adheremeter averages of group A and group B in T0-T1 and T2-T3.

In group A ***(Tab. 5)*** we find a pre-treatment (T0) VAS value of 3.4 on average and a post-treatment (T2) VAS value of 1.5; for a pain decrease value of - 1.9.

In group B ***(Tab. 6)*** the mean pre-treat-

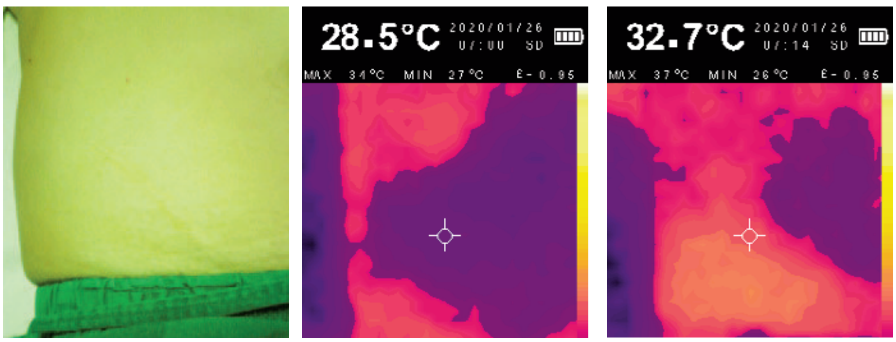


Foto della cicatrice **Foto pre-trattamento** **Foto post-trattamento**

Fig. 8 - Abdominal scar (group B), photo taken by thermal imaging camera before and after treatment. Surgical scar of the abdomen for peritonitis outcomes (scar age 35 years).

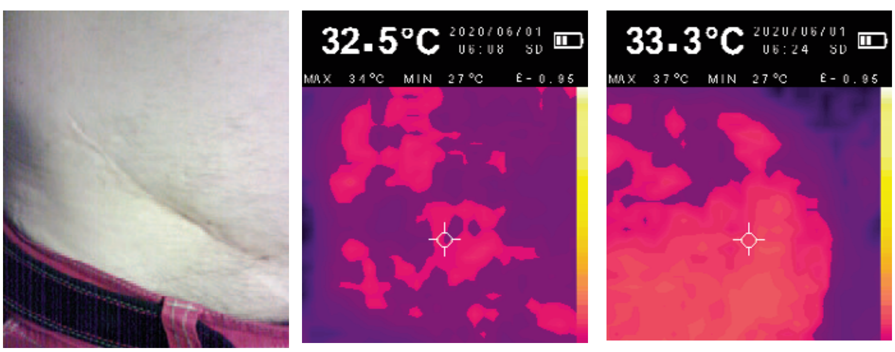


Foto della cicatrice **Foto pre-trattamento** **Foto post-trattamento**

Fig. 9 - Abdominal scar (group B), photo taken by thermal imaging camera before and after treatment. Surgical scar of the abdomen for appendicitis outcomes (scar age 38 years).

Tab. 5 - Group A averages in T0, T2 and improvement scores.

Group A VAS		
T0 Average	*T2 Average*	*Improvement Score*
3.4	1.5	-1.9

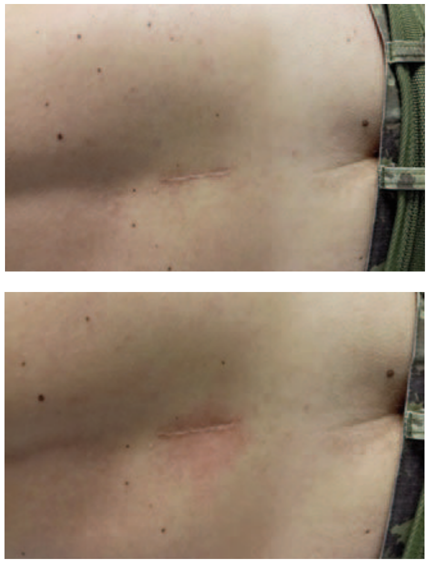
Tab. 6 - Group B averages in T0, T2 and improvement scores

Group B VAS		
T0 Average	*T2 Average*	*Improvement Score*
3.7	2.2	-1.5

ment (T0) VAS results had a score of 3.7 and a mean post-treatment (T2) of 2.2; for a pain decrease value of - 1.5.
Table 5 shows the results of the VAS scale averages of group A and group B in T0-T1 and in T2-T3.

Discussion

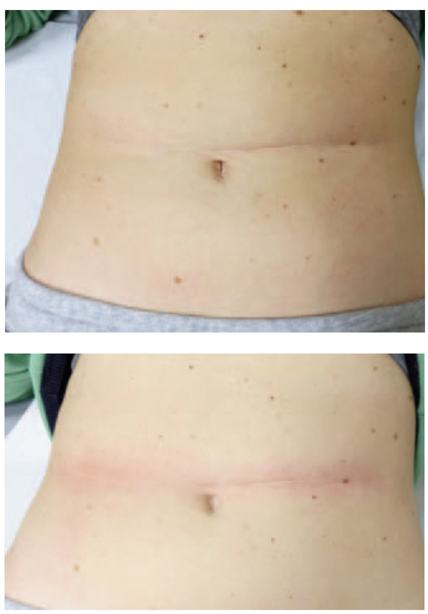
In the light of the results obtained from the temperature measurement after the two treatment sessions (T1 and T3) of the scar tissue, an increase in the local temperature and a more homogeneous distribution of vascularisation in both groups and in group B, as the location of the scars is in a richly vascularised area, which responds readily to the local manipulative treatment, are evident.
Figures 10 and 11 show photos of the scars before and after manual treatment ***(Figures 10, 11).***
The most accredited hypothesis is that this temporary increase in blood flow leads to a stimulation of the collagen fibres that promote tissue mobility and that tissue plasticity remains even in scars that have never been treated, regardless of the age of the scar, as we can observe by comparing Figures 6 and 9, which refer to scars of very different ages (1 year and 38 years) whose response, in the increase and homogeneity of the vascularisation, is superimposable.



Pre and post treatment picture

Fig. 10 - Lumbar spine scar (group A). Pre and post treatment picture.

In the evaluated scars with reduced mobility compared to the underlying planes, the results of the Adheremeter tests show an improvement in post-treatment mobility (T2) in both groups, greater in group B.



Pre and post treatment picture

Fig. 11 - Abdominal scar (group B).

The VAS scale although having a similar mean in the two groups shows an improvement of the nociceptive sensation more in group A. We can hypothesise that adequate stimulation resulting from manipulative treatment produces a very pronounced local tactile proprioceptive stimulus, especially after surgery.

Conclusions

This study shows that manipulative treatment of surgical scars produces a loco-regional reaction regardless of scar age and site.
Manipulative treatment decreases nociceptive aberrations and significantly improves the local temperature of the scar tissue with stimulation of fibroblasts and collagen production; in association, fascial unwinding techniques improve the mobility of scars in all their directions. The decrease in adhesions promotes the elasticity of the fascial system and assists in the release of non-physiological tension, allowing the general homeostasis of the fascial system freedom of expression.
This first pilot study made it possible to highlight the criticalities to which the fascial system is subjected after surgery. The limitation of mobility, the repercussions on the local vascularisation, the nociceptive alterations, and the modification of the mechanical forces, while deserving a more in-depth evaluation, may find relief with the application of manual techniques on the scars. This evidence needs to be confirmed with further scientific studies involving larger samples.

Disclaimers:

The author declares that he has no conflicts of interest.

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