Case Report

sb&h

Scars, Burns & Healing
Volume 8: 1–10
DOI: 10.1177/20595131211058430
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Case study: Pilot testing of a local acupuncture intervention protocol for burn scars

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Abstract

Background: Following burn injury and a prolonged duration of healing, scars may become hypertrophic, causing movement restriction, increased scar thickness, colour and pliability, and symptoms such as pain and itch. Acupuncture has emerged as a potentially beneficial treatment for neuroinflammation, which perpetuates the negative features of hypertrophic scars. The aim of this study was to pilot test an evidence-based methodology for applying and measuring the clinical effects of localised acupuncture for symptomatic scars, in a patient with a healed burn injury.

Methods: A 71-year-old caucasian male presented with a hypertrophic scar that was painful and itchy after burn injury and subsequent skin grafting. He received acupuncture and massage treatment local to his scar as per the local (verum) group of the author's clinical trial under recruitment. Needles were inserted around the circumference of the skin grafted area and adjacent to areas of raised scar tissue within the grafted area and stimulated via bi-directional rotation. Outcome measures included a Numerical Rating Scale (NRS) for pain and itch, Patient and Observer Scar Assessment Scale (POSAS) self-assessment component and SF36 quality-of-life measure to capture any non-specific acupuncture effects.

Conclusion: Acupuncture applied locally around the scar was associated with short-term relief of symptoms and significantly reduced his subjective outcome measure scores relating to scar thickness, redness and pliability out to six months after injury. Some short-term increase in symptoms occurred on several occasions following treatment; however, treatment was well tolerated supporting the use of this protocol for a larger future clinical trial.

Keywords

Scar, hypertrophic scar, burn, acupuncture, itch, scar pain

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Lay Summary

Following injury to the skin, scars can become raised, red and reduce movement. Other common symptoms may include pain and itch. Previous studies suggest acupuncture may help symptomatic scars, but more research is needed to confirm this with larger samples of patients.

This case study tested the active treatment protocol for a clinical trial using acupuncture on symptomatic scars. A 71-year-old white man had a burn scar on his torso after a workplace accident. His treatment involved scar massage and local acupuncture. The acupuncture needles were inserted around the skin graft borders and thickened bands of scar tissue.

Outcomes were measured using surveys recording symptoms, scar characteristics and quality of life. These were used to assess treatment effect and how well the protocol was tolerated. Over the course of treatment both pain and itch improved

This case report showed that the treatment protocol was well tolerated, and that local acupuncture was associated with improved scar symptoms and physical characteristics up to six months after injury.

Introduction

Formation of hypertrophic scars after burn injury may contribute to loss of function and disfigurement in affected individuals.[1–3] Skin grafting is used in acute burn injuries to restore the mechanical barrier and protect the excised damaged tissue. Although this minimises ongoing tissue damage and infection, it does not promote regeneration, and repair occurs with scar tissue formation.[1] Several factors after burn injury can lead to scars becoming hypertrophic. These include severity (extent and depth) of the injury, infection, time to heal and prolonged inflammation beyond two weeks.[4] The resulting hypertrophic scar may be painful, itchy and/or restrict mobility of the surrounding joints due to the contractile activity of collagen stimulated by inflammation.[5] After burn injury and subsequent skin transplantation, nerve ingrowth into the graft tissue occurs at different rates with unmyelinated fibres being most plentiful in the months immediately after injury.[6] These unmyelinated fibres may cause increased sensitivity to noxious stimuli. This occurs through the release of neuropeptides including Substance P – consequently facilitating neurogenic inflammation in the tissue.[6] Nociceptive input via the peripheral nervous system can trigger sensitisation of the central nervous system and lead to hyperalgesia (increased sensitivity to painful stimuli) and allodynia (pain caused by non-nociceptive stimuli).[7] A systematic review found that intrinsic scar pain is most often reported in hypertrophic or burns scars.[8] Furthermore, after burn injury, the size and depth of the burn was found to be predictive of the development of scar pain.[8]

Standard conservative treatments often include the use of pressure garments, silicone, topical creams, gels and massage.[1,2] Pressure garments have been used over many years and have been shown in some studies to reduce scar thickness[9,10]; however, effectiveness has been questioned by other authors.[11] Use of pressure garments combined with silicone gel sheets was shown to improve scar colour, thickness, vascularity, elasticity and texture.[12] However, use of a cohesive silicone bandage that applied compression as well as silicone added a significant improvement in scar itch compared to silicone gel sheeting and pressure garments.[12] Neither silicone gel sheeting[13] nor cohesive silicone bandages[12] have demonstrated a significant reduction in scar pain. Scar massage has shown promising results; however, studies are poor quality and use inconsistent treatment and assessment protocols.[14] Although widely used and accepted as a treatment modality, use of specific categories of moisturisers or creams for scars has not been supported by research.[15]

Previously published case studies reported positive outcomes for the use of acupuncture to reduce pain and itch in symptomatic scars.[16–19] These case studies used manual or electro-acupuncture for hypertrophic and keloid scars after surgery or burn injury. The number of treatments delivered along with treatment parameters (needle retention time, stimulation, number of needles) differed from case to case. However, the authors reported improved physical characteristics (colour, height, pliability), reduced pain and improved mobility in surrounding joints of scarred skin following acupuncture treatment.

Due to the scarcity of data and consistent protocols for the use of acupuncture for treating symptomatic scars, the ideal treatment parameters to achieve optimal results is unknown.[20] Acupuncture needles inserted locally into skin supplied by the same spinal segmental nerve level as the target tissue (also known as segmental needling)[21] targets local nociceptors and connective tissue. This is compared to extrasegmental or distant acupuncture, where needles are inserted into skin or muscle without linked neuroanatomy through related dermatomes and myotomes.[21] Extrasegmental needling is applied at a distance to the target tissue in order to prevent proximity-related neural stimulation.[21] Manual or electrical stimulation of acupuncture needles causes widespread activity in the cortical, subcortical, limbic and brainstem areas of the central nervous system.[7,22–24] These areas are involved in a diverse range of functions including sensory, locomotor, cognition, sleep, emotion and visceral functions[23] and may contribute to non-specific acupuncture effects. As extrasegmental acupuncture is not an inert control treatment, it may produce similar non-specific acupuncture effects as local segmental acupuncture.[25,26]

This case study aimed to pilot test a standardised methodology to explore the feasibility and sensitivity of clinical outcome measures to assess change associated with using local acupuncture. This standardised methodology is designed for use for a larger, future clinical trial, investigating acupuncture effect on both postoperative and post-traumatic symptomatic scars. Specifically, this case study assessed patient tolerance and adherence to the treatment protocol, and compliance with outcome measures both during the treatment period and follow-up after treatment cessation.

Patient demographics

This case study depicts the treatment journey of a 71-year-old otherwise healthy Caucasian male (A.B.), previously employed full-time as a mechanic in Western Australia.

Patient history

While using an oxyacetylene cutting torch at work, A.B.'s shirt caught fire resulting in a third-degree burn to his left lateral torso. He received minor burns to the fingers on his left hand, which he had used to try and extinguish the fire. A.B. was admitted to Fiona Stanley Hospital (FSH) in Perth and underwent skin graft surgery using skin off his left anterior thigh to his left lateral torso. The grafted wound was assessed to be cellulitic in the first week after injury; however, this settled with a course of intravenous antibiotics followed by oral antibiotics. He was discharged from hospital with compression garments and expected he would need to wear them for two years. A.B. was referred by his general practitioner (GP) for a gym-based exercise programme under the supervision of an exercise physiologist early post-injury and commenced a gradual return to work program of light duties and reduced hours.

AB's wife had been massaging his thoracic scar once or twice daily for approximately 10 min each day after hospital discharge. He reported that he was wearing his compression garment 23 h per day (as per routine practice of the State Adult Burn Unit at FSH) and attended the gym three times per week.

Three months after his burn and initial treatment, A.B. was referred by his GP (who had seen a recruitment flier for the author's clinical trial) for 12 sessions of massage and acupuncture treatment for the scar on his thorax. Throughout the course of his treatment, A.B. continued with his previous regimen of massage, stretching and exercise. All medical costs for his injury were covered by Workers Compensation Insurance.

Initial clinical presentation

During his initial appointment, A.B. reported that the burns on his left hand had healed and those skin changes were no longer symptomatic. The scar on his left lateral thorax was symptomatic (pain and itch), and he experienced some pulling during movement but had unrestricted shoulder and thoracic spine range of motion (ROM). Reduced sensation was noted around some sections of the thoracic scar.

Before commencing the acupuncture treatment protocol, A.B. reported that he remained working on reduced hours compared to normal and that these had been gradually increasing. At the start of this treatment protocol, he was working 75% of his usual hours and had restricted lifting capacity to a maximum of 5 kg (approximately 15% of his workplace maximum). A.B. was performing a combination of light cleaning tasks, administrative duties and mechanical work, rather than full-time mechanical duties with no lifting restrictions.

Methods

Standardised local acupuncture treatment for scars

Before receiving treatment, A.B. was assessed for scar size and screened for medical conditions that may contraindicate treatment. He received a handout containing current World Health Organization (WHO) recommendations regarding cardiovascular exercise and instructions for self-massage of his scar. The number of acupuncture needles used was calculated based on placing needles at 2-cm intervals surrounding the scar, limited to a maximum of 20 needles to avoid overstimulation. Outcome measures were assessed/requested based on the following schedule from the clinical trial protocol (Table 1):

Each treatment involved 5 min of scar massage aimed at moving layers of connective tissue on each other, followed by 15 min of acupuncture. The needles were stimulated manually via bi-directional rotation until moderate deqi, or needling sensation was felt, three times over the course of each 15 min treatment session. These parameters were chosen as it has been confirmed that the stimulation of needling sensation is vital for producing acupuncture analgesia and that the analgesic effects of acupuncture build slowly over the course of the treatment and continue after treatment cessation.[27] Local acupuncture treatment aims at increasing blood flow and stimulating remodelling of collagen fibres.[28]

Methods applied to this case study

A.B. was referred for inclusion in a clinical trial (UNDA Ethics #017029F) and the methodology for the study was piloted with his consent. The opportunity arose because he met the participant inclusion criteria, but he was unable to be randomly assigned to either treatment group as he had been referred by his doctor for a defined number of treatment sessions, under Workers Compensation Insurance provisions. As his scar and symptoms met inclusion criteria, he gave permission for his data and photographs to be published as a separate pilot (case study). He received a total of 12 treatment sessions over seven weeks, which is double the number of treatments in the clinical trial and this was specified in his referral from his doctor/case manager. After scar massage, as per the standard protocol, A.B. received localised acupuncture treatment applied surrounding the entire skin graft area. Some needles were also inserted inside the grafted area adjacent to prominent red, raised bands of scar tissue. For each treatment 20 needles were inserted to a depth of 10 mm under the skin at a 45° angle so that 20 mm of the needle shaft was inserted at an angle underneath the edge of the scarred tissue.

On several occasions, the patient reported greater sensitivity over his skin grafted area when he arrived for treatment coming straight from a day at work. This was postulated to be a combination of factors including heat and rubbing from work clothing and repetitive motion of his arm during work duties. Hence, needles were only placed around the entire scar border (into unaffected skin) to avoid overstimulation on these occasions, avoiding the central raised bands.

Outcome measures were taken before commencement of treatment, at his final treatment session and via a phone call follow-up 10 weeks after treatment completion. The phone call was undertaken after no reply to emails including requests for previously consented to post-treatment questionnaires. The three outcome measures were used. The Patient and Observer Scar Assessment Scale (POSAS) patient rating component was utilised at baseline and at points after treatment cessation as this asks the patient about scar symptoms as well as the appearance and impact of the scar over the preceding few

Table 1. Schedule of Outcome Measures.

Outcome measure	Baseline	Before each session	Midway	Final session	1 month later	2 months later
POSAS	√		√	√	√	√
NRS	√	√	√	√		
SF-36	√			√	√	√

NRS, Numerical Rating Scale for Pain and Itch; POSAS, Patient and Observer Scar Assessment Scale – patient response component; SF-36, Quality of Life Measure.

weeks.[29] A short-term measure, the Numerical Rating Scale (NRS) for pain and for itch was used at the beginning of each treatment session. This averages symptoms on a scale of 1–10 over the past 24 h and was used to assess reaction to the previous treatment and scar sensitivity on the day of treatment and guide treatment intensity. Quality of life was measured using the SF-36 which has been validated for use with burns survivors, as well as the general population.[30] This was completed during his initial assessment with the assistance of his wife due to language difficulties. Unfortunately, this measure was not able to be captured after his baseline measure. This outcome measure was included to test the ease of capture of quality-of-life information, and to explore non-specific acupuncture effects. This was for the comparison between verum and control protocol in a future clinical trial.[31]

Results

On initial presentation, A.B.'s skin grafted area was pink with a dark red raised horizontal band and slightly raised pink vertical band of hypertrophic scarring (Figure 1). Halfway through the treatment series (four weeks after his initial treatment), the main grafted area of scar was lighter pink. The raised horizontal band was less raised and had lightened to red, with a section in the centre that had completely flattened and changed colour to pink. The vertical band was barely distinguishable from the main section of the scar (Figure 2a and b). Seven weeks after initial treatment at his final (12th) session, the main section of scar was light pink. The horizontal band had reduced in size, with only a small section still raised and red, and the vertical band was no longer visible (Figure 3).

At his final follow-up (via phone call) seven months after his burn injury, the patient reported that he was working fulltime, performing all his normal duties. However, he reported that heat and repetitive arm movements were causing some scar irritation from the rubbing of clothing against his scar (Table 2).

Adverse events

The patient complained of some increased scar pain immediately after treatment; this required his usual pain medication and settled within 12 h after treatment. Some irritation/pain after treatment was expected due to the increased neural sensitivity of his scar. A.B. was asked to rate his pain and itch (on an NRS) at the beginning of each session and if he was already experiencing work-related symptom aggravation before treatment the needle stimulation intensity was reduced for that session. Future research could consider using less needles initially and increasing needle numbers throughout the course of treatment to increase stimulation intensity in line with patient tolerance.

Table 2. Results.

	Initial assessment (3 months after burn injury)	At final treatment (7 weeks after treatment commenced)	Follow-up (10 weeks following treatment cessation, 7 months after injury)
NRS (pain)	7/10	4.5/10	6/10
NRS (itch)	5/10	4/10	5/10
POSAS	57/70 (81%)	27/70 (38%)	33/70 (47%)
SF-36	Summary scores (%) PCS – 29, MCS – 46 Domain scores (%) PF – 15 (74*) RP – 44 (71*) BP – 31 (75*) GH – 45 (81*) VT – 44 (60*) SF – 63 (91*) RE – 38 (88*) MH – 75 (87*)	Patient declined to complete	Unable to complete over the phone

*With mean age- and gender-based domain score for comparison.[31]

BP, bodily pain; GH, general health; MCS, mental component summary; MH, mental health functioning; NRS, Numerical Rating Scale for Pain and Itch; PCS, physical component summary; PF, physical functioning; POSAS, Patient and Observer Scar Assessment Scale – patient response component; RE, emotional role functioning; RP, physical role functioning; SF, social role functioning; SF-36, Quality of Life Measure; VT, vitality.

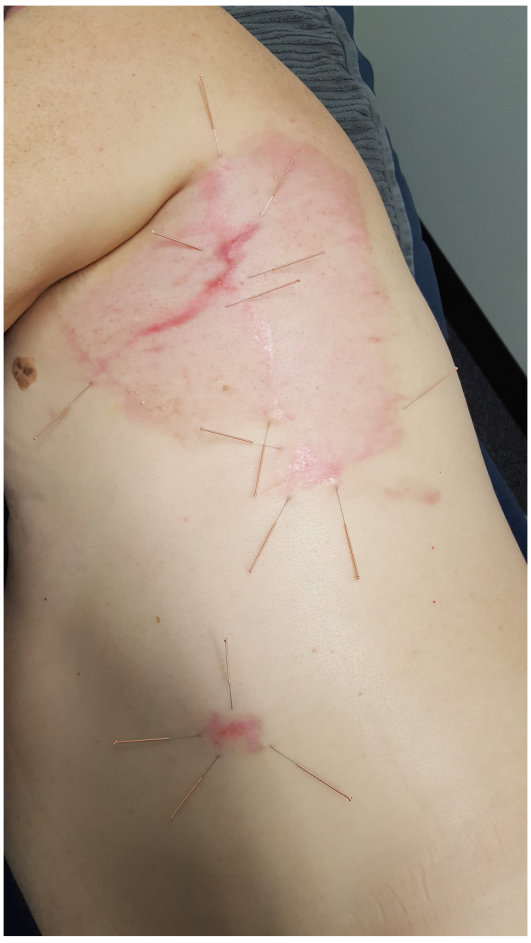

Figure 1. Needle position during first treatment (image captured by the patient's wife and reproduced with permission).

Discussion

This case study related to the pilot testing of a local acupuncture treatment protocol for hypertrophic scars for an infected burn which received skin grafting. The treatment protocol was developed and based on the available evidence arising from the authors' recent review of the efficacy of acupuncture in treating scars.[20] The clinical trial protocol involved random assignment to either an active group who received local acupuncture treatment or a control group who received distant, non-segmental acupuncture treatment. A.B. received the verum local acupuncture treatment protocol. The acupuncture needles were inserted into skin supplied by the same spinal segmental nerves as the target tissue, also known as segmental needling.[21] No significant adverse effects were reported over the course treatment, which is promising for a patient with such a large scar and history of skin graft and subsequent infection. The treatment methods were well tolerated by A.B., supporting its use in a larger clinical trial. This case study also examined sensitivity and compliance with regards to outcome measures used and highlighted the challenge of using written questionnaires in participants with poor written English ability. In this case, initial measures were completed with the assistance of A.B.'s wife, then verbally with the treating therapist. Other potential methods for future data collection could include digital questionnaires or use of a translated version of the original questionnaire.

Clinically relevant symptom reduction was measured via POSAS and a NRS for pain and itch over the course of treatment supporting the use of these measures to assess treatment effect.[32–34] Symptoms of pain and itch improved 10%–15% over the course of treatment; however, short-term symptom reduction was reported by the patient. Pain was reduced by 1.5/10 after treatment and 1/10 at follow-up. Itch reduced by 1/10 after treatment, but this was not retained on 10-week follow-up. Significantly, the POSAS score dropped from 81% to 38% after treatment and remained at 47% on follow-up, indicating that self-perceived improvement of factors such as scar pigmentation, height and pliability were maintained over time. These measures were completed in person throughout the treatment series and via follow-up phone consultation. Regrettably, the symptom of itch did not reduce appreciably with treatment. There are several possible reasons for this. Due to the location of his scar, A.B. complained that heat, sweat and rubbing from his clothing irritated it despite wearing either his compression garment or later a cotton singlet. Due to the location of his scar in the proximal axilla region and body contours, it is possible that his compression garment was less effective at maintaining consistent skin contact in this area during repetitive arm movements. Because he worked as a mechanic, his regular arm and trunk movements may have created friction between skin and clothing. This may have stimulated mechanosensitive nociceptors of histamine and other pro-inflammatory neuropeptides such as Substance P, therefore leading to neurogenic inflammation of the skin grafted region.[35,36] During treatment, insertion and stimulation of acupuncture needles activate the same sensory neurons as does tissue damage, leading to local histamine release.[23,27] This may cause a short-term increase in symptoms.[23] Further, due to lack of standardisation in measuring itch and

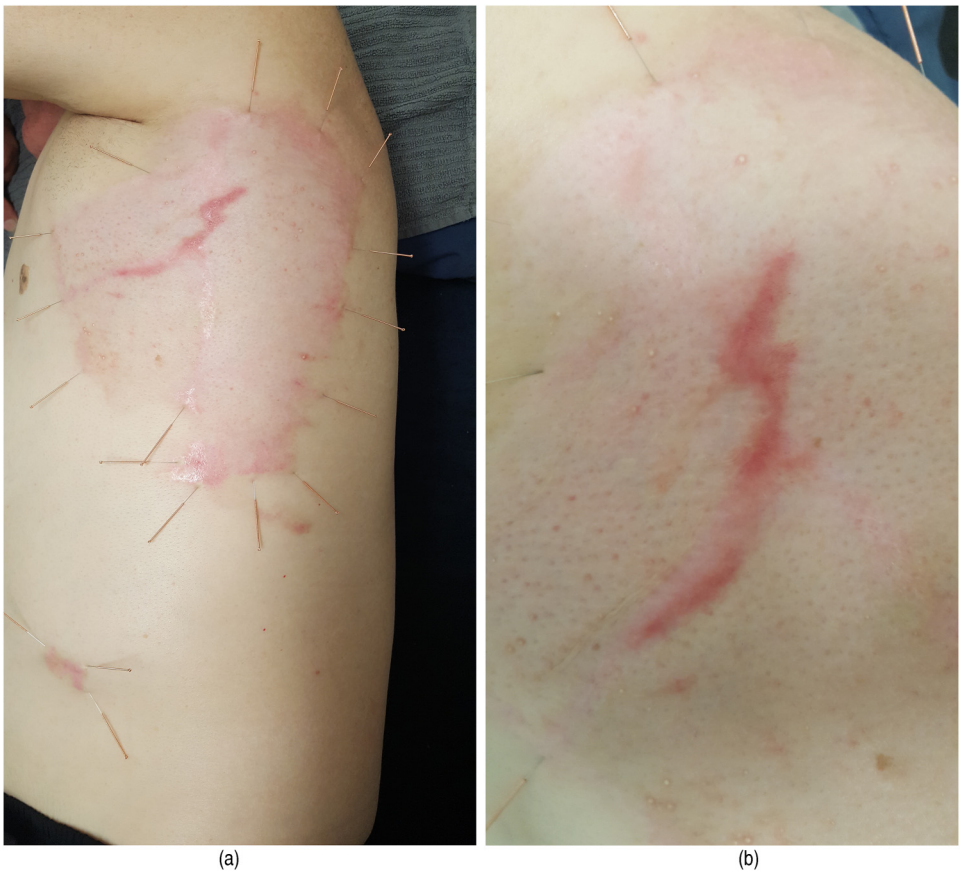

Figure 2. (a) Example of needle placement surrounding the entire grafted area. (image captured by the treating therapist at his sixth treatment and reproduced with permission).
(b) horizontal band within scar area, centre has flattened and colour is changing from dark red to pink (image captured by the treating therapist at his sixth treatment and reproduced with permission).

applying acupuncture for itch, the published literature to date does not support its use in treating itch.[37] It is currently unknown whether use of segmental (shared neuroanatomy) needle placement further away from the tissue under consideration or extrasegmental needle placement (no shared neuroanatomy) influences itch. This requires further investigation; therefore, the proposed clinical trial protocol compares the use of local segmental acupuncture with distant extrasegmental acupuncture. Extrasegmental acupuncture is not an inert control treatment; hence its use may produce non-specific acupuncture effects including potential effects on symptoms under investigation.[25,26]

Physical scar characteristics of pigmentation, height and pliability as measured by the POSAS (patient self-assessment) improved following treatment consisting of scar massage and local acupuncture. Bi-directional needle rotation is reported by Langevin and colleagues to influence fibroblast cellular activity in a dose-dependent manner via winding of collagen fibres around the needle.[28,38] This effect was demonstrated to occur up to 4 cm away from the shaft of the needle and is hypothesised to cause local collagen fibre remodelling.[39,40] Therefore, use of local acupuncture treatment with bi-directional rotation until moderate needling sensation (deqi) is felt, may contribute to physical changes in scar pigmentation, height and pliability via stimulation of collagen remodelling within the scar tissue and warrants further investigation.

The SF-36 was validated for burns patients and provides valuable information that could be useful in understanding non-specific treatment effects of acupuncture.[30] A.B. scored significantly lower on all domains of the SF-36 compared to age-matched controls, demonstrating both his physical and mental health had been affected by this injury. Unfortunately, this was only captured at baseline. A.B. declined to fill this in at his final appointment and follow-up. Due to the length of the questionnaire, completion via telephone was not feasible. For these reasons, the use of a shortened

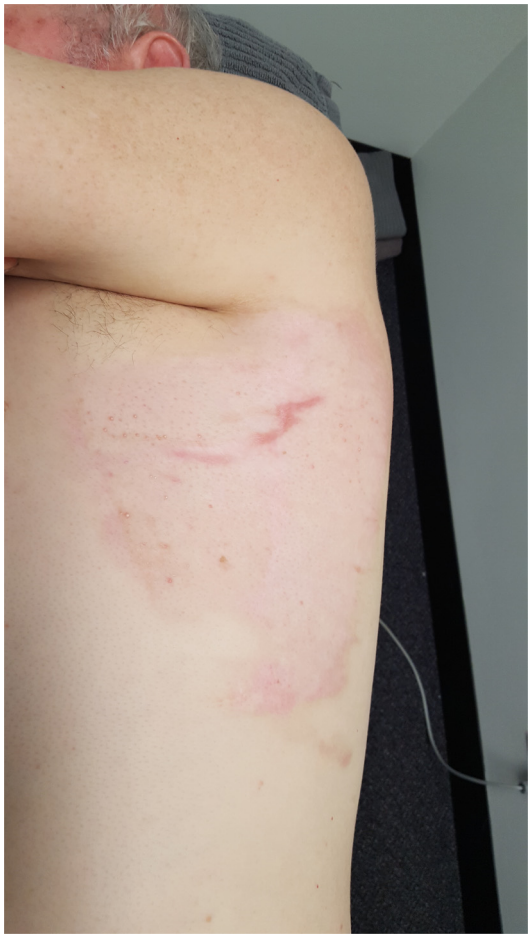

Figure 3. Scar outcome as at final acupuncture treatment (image captured by the treating therapist and reproduced with permission).

quality-of-life measure might be beneficial when patients have difficulties with written language. The SF-36 can be mapped to the EQ5D which only has five questions and was found to provide similar predictions with the exception of severe health states.[41] This is an appropriate substitution for future clinical trial cohorts in order to provide some follow-up data for comparison. However, the SF-36 provides valuable detail across multiple domains and is therefore the questionnaire of choice where logistically possible.

While this case study showed promising results in a single patient, factors such as age may influence tissue healing and scar characteristics. It cannot be ascertained from a single case whether the improvement was more rapid than a normal healing response, nor can outcomes be generalised to other populations with burns or postoperative scars. Further testing of this protocol is warranted to determine whether the recommendations arising from this case study should be applied.

Conclusion

This case and applied intervention were associated with a significant change in patient-observed physical scar characteristics with a small but clinically relevant reduction in scar pain. The treatment protocol was well tolerated, and outcome measures sensitive to change. A larger trial with standardised treatment, as proposed below, is warranted to investigate the effect of acupuncture on hypertrophic scar symptoms in patients with postoperative or burns scars, of various ages and stages of healing.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

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Appendix

Proposed comparison groups for clinical trial

Group 1 – Local acupuncture (demonstrated in this case study)

Following standard scar massage, acupuncture treatment will consist of 30 mm × 0.25 µm acupuncture needles placed 2 cm apart around the borders of the scar. Needles will be inserted as close as possible to the margins of the scar (1–5 mm away) to a depth of 5–10 mm angling underneath the margins of the scar. In the case of hypersensitivity, the needles will be placed at a distance from the scar tolerable to the patient. Needles will be left in situ for 15 min. Manual stimulation will be applied via bi-directional rotation of the needle for 30 s or until moderate sensation (deqi) has been described by the participant. This stimulation will be repeated at 5-min intervals at the time points of 5 and 10 min, and immediately before needle removal.

Group 2 – distant acupuncture (control condition #1)

As participants will have scars in different body areas, they will therefore require different needle placement between participants to avoid any segmental neuroanatomical links to the scar being treated.

Following standard scar massage, acupuncture treatment will consist of 30 mm × 0.25 µm acupuncture needles inserted to a depth of 5–10 mm perpendicular to the skin. The number of needles used will be calculated as per the local treatment group depending on the size of the scar, so that the same number of needles will be used relative to the size of the scar for each participant. No more than 20 needles will be used per participant. Needles will be left in situ for 15 min as with the local acupuncture group. Manual stimulation via bi-directional rotation of the needle for 30 s or until moderate sensation (deqi) has been described by the participant, repeated at 5-min intervals will be applied at the time points of 5 and 10 min, and immediately before needle removal.

The therapist will insert acupuncture needles bilaterally to the following locations based on using points extrasegmental to the scar location as segmental needling has been demonstrated to confound sham needling attempts in acupuncture clinical trials.[21] Points used will be recorded for each patient, along with number of needles to allow consistent treatment to be applied throughout the treatment series.

1. Scar located on upper limb, face, chest or upper back – 2 cm lateral to the spinous process of L3 and L4, midline of the posterior thigh 5 cm and 10 cm above the knee crease, 5 cm below the knee crease.
2. Scar located on lower limb, lower back or abdomen (below umbilicus) – 1 cm lateral to the spinous process of C7 and T2, 5 cm and 8 cm above the elbow joint in the midline (posterior), midpoint of the forearm between the radius and ulna (dorsal surface).

If extra needles are required based on scar size measurements, these will be placed at 2-cm intervals from the needles placed in the upper and lower limbs and recorded for consistent placement at each treatment session.

These points have been selected at a distance from one another, in order that this protocol seems realistic to participants with previous acupuncture experience as they will not be excluded from participation in this trial. They are also designed to avoid any neuroanatomical links to the scar being treated, which would confound results.[21]

Group 3 (control condition #2) – proposed as an additional group for future studies

Participants receive standard scar massage as per groups 1 and 2 but no acupuncture treatment.

How to cite this article

Tuckey CR, Kohut SH and Edgar DW. Case study: Pilot testing of a local acupuncture intervention protocol for burn scars. *Scars, Burns & Healing*, Volume 8, 2022. DOI: 10.1177/20595131211058430.