

An exploratory study on the efficacy of
reflexology for pain threshold and
tolerance using an ice-pain experiment and
sham TENS control

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Mode of Action

- Reflexology is thought to work through the responses of the nervous system
- fMRI shows somatotopical relationships (Miura *et al.* 2013, Nakamaru *et al.* 2008)
- Changes occur in the blood circulation as a consequence of a reflex stimulus (Mur *et al.* 2001)
- May attenuate pain through a gating system (Melzack and Wall 1965)

Exploratory study aims

- To examine the effects of a standard reflexology treatment on acute pain induced in healthy human volunteers
- To evaluate pain induced threshold and tolerance levels
- To measure basic physiological parameters such as heart rate

Inclusion - Exclusion criteria

- Inclusion criteria –
 - Healthy adults between 18 – 55 years
 - No previous experience of reflexology or T.E.N.S
- Exclusion criteria –
 - pregnancy, thrombosis, pain condition, severe psychiatric or somatic illness, Raynauds syndrome or other neurological condition, clinical hypertension, interest in outcomes of the study

Methods

The Subjects:

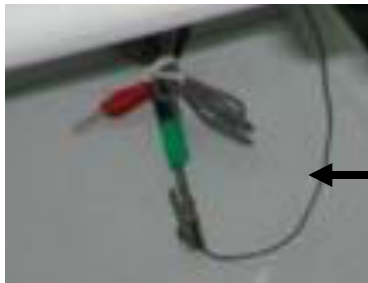
- Nineteen subjects recruited
- Four left the study
- Healthy volunteers $n=15$ (11 female, 4 male) with a mean age 37.7 ± 2.6 years
- Each assigned a single treatment of reflexology and sham T.E.N.S. given randomly in a cross-over design, total time for each trial = 3 hours

Control Method

- Establishing a sham treatment that does not produce some measurable physiological effect
- Sham reflexology, using unrelated areas of the feet, are an inadequate control in clinical trials (Oleson and Flocco 1993, Evans *et al.* 1998, Brygge *et al.* 2001)
- Sham Transcutaneous Electrical Nerve Stimulation (T.E.N.S) used as a control in T.E.N.S. naïve subjects (Claydon *et al.* 2008)

Basis of T.E.N.S

- Clinical tool in the treatment of pain that involves passing low voltage electrical currents to electrodes pasted on the skin via small pads
- Sham T.E.N.S –
no electrical current



Experimental Procedures

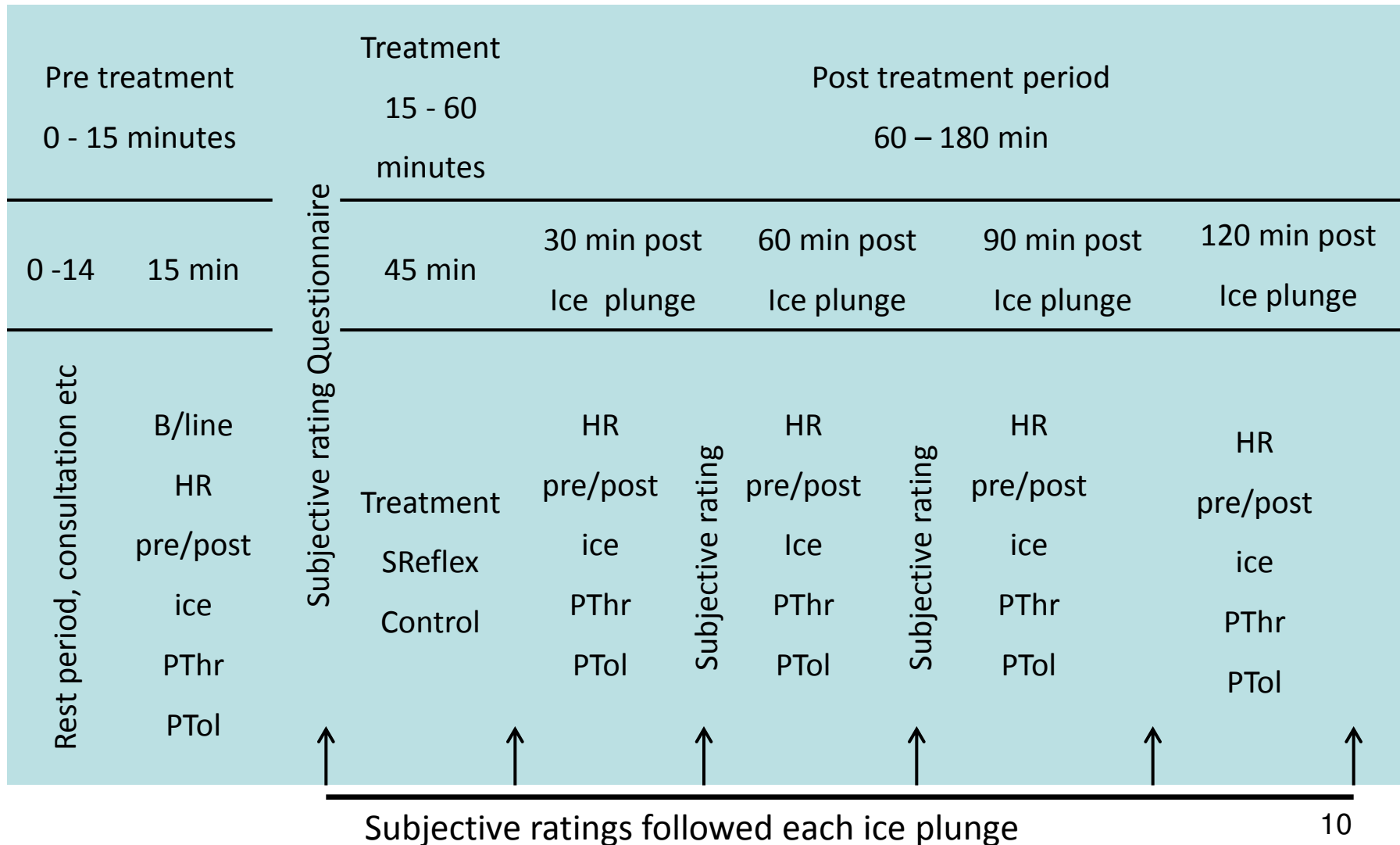
- Isolated room, ambient temperature $22^{\circ}\text{C}\pm 1^{\circ}\text{C}$
- Seated in a chair and fitted with a heart rate monitor
- Plunged non-dominant hand into a bucket of crushed ice (0°C)



Experimental procedure

- 15 minute rest period
- Three measurements were taken: -
- Pain threshold
 - Pain tolerance
 - Heart rate before and after plunging the hand into the crushed ice (baseline)
-
- A 45-minute general reflexology treatment or 45-minute sham T.E.N.S. treatment
-
- 30-minutes rest between ice plunge

Experimental procedure



Statistical Analysis

- Data are expressed as change from pre- treatment baselines
- Two-way analysis of variance (ANOVA) with repeated measures for treatment and time
- Inter-session reliability of baseline data evaluated using Pearson's product moment correlation coefficient statistic

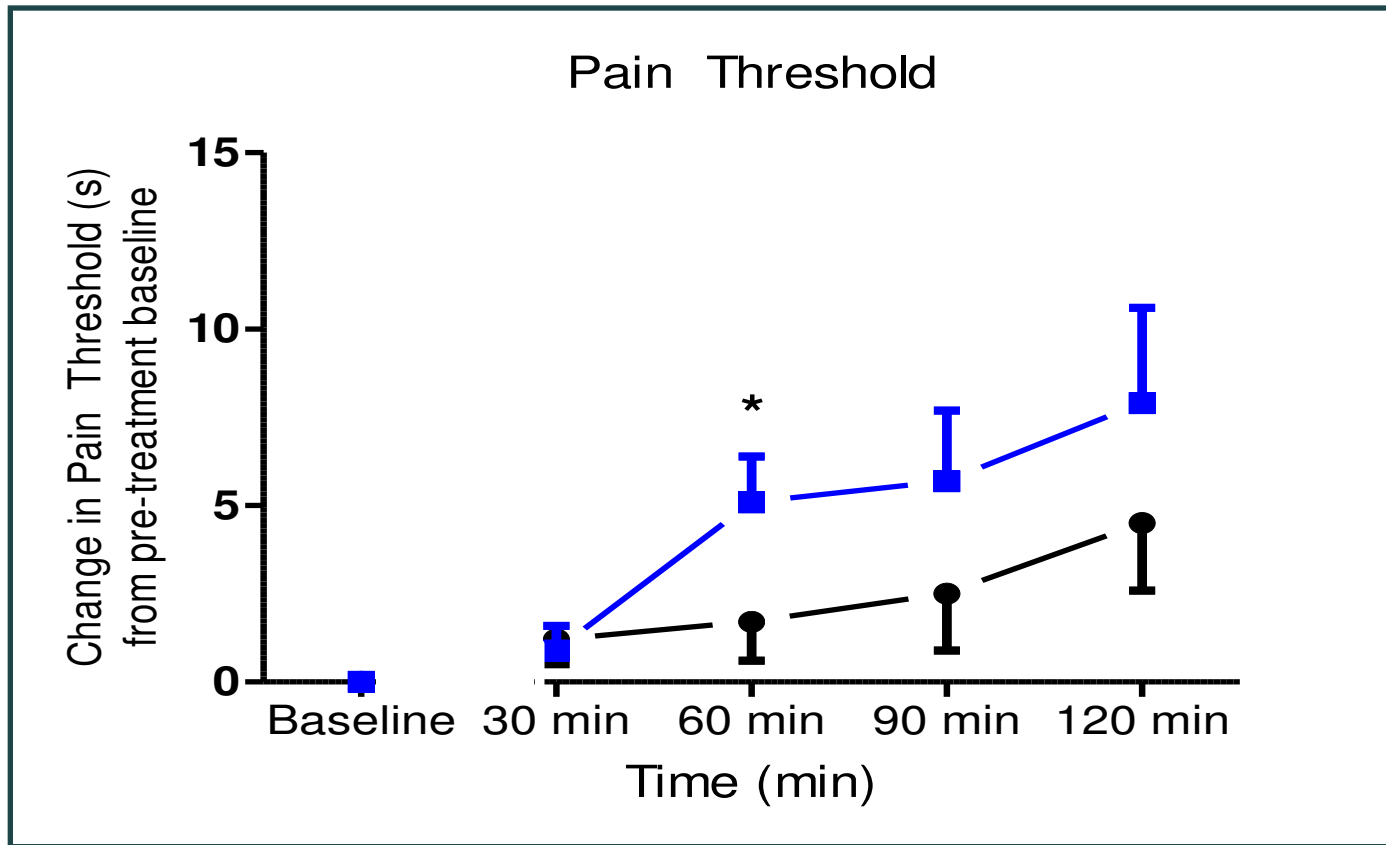
Pain Threshold Data

<i>Group</i>	<i>Pre-treatment baselines</i>	<i>Post treatment (+30 min)</i>	<i>Post treatment (+60 min)</i>	<i>Post treatment (+90 min)</i>	<i>Post treatment (+120 min)</i>
Control	8.4 ± 0.8	9.6 ± 0.8	10.1 ± 1.5	10.9 ± 1.8	12.9 ± 2.5
Reflexology	9.1 ± 1.2	10.0 ± 0.8	14.1 ± 1.6	14.7 ± 2.6	17.0 ± 3.7

Mean ± SEM for pain threshold (s) by group and by time showing 1 pre treatment and 4 successive post treatment observations at 30 minute intervals. $n=15$.

Treatment ($F_{(1,14)}=0.6644, n.s.$), time ($F_{(3,42)}=4.2629, p<0.01$), treatment x time interaction ($F_{(3,42)}=0.3481, n.s.$).

Results for Pain Threshold



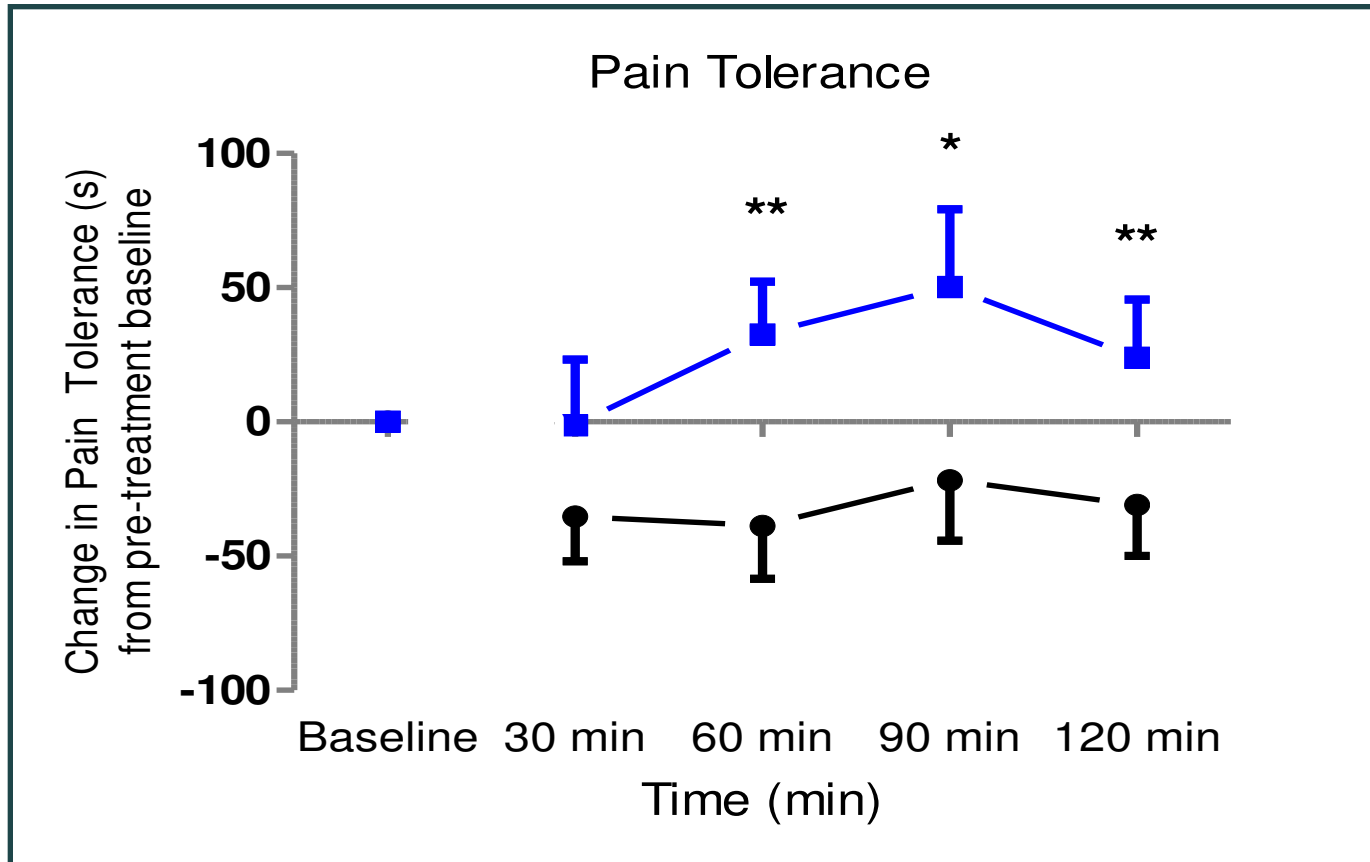
The effect of change in pain threshold from pre-treatment baselines, $n=15$. Mean \pm SEM pain threshold scores (s), $p < 0.05$ for standard reflexology. Vertical lines represent \pm SEM. ●=Sham TENS (control) ■=Reflexology

Pain Tolerance Data

<i>Group</i>	<i>Pre-treatment baselines</i>	<i>Post treatment (+30 min)</i>	<i>Post treatment (+60 min)</i>	<i>Post treatment (+90 min)</i>	<i>Post treatment (+120 min)</i>
Control	133.7 ±31.0	98.3 ± 24.6	95.0 ± 26.8	111.9 ± 9.0	102.7 ±26.6
Reflexology	112.7 ±27.9	111.3 ±30.2	145.3 ±33.2	162.9 ±36.7	136.5 ±34.6

Mean ± SEM for pain tolerance (s) by group and by time showing 1 pre treatment and 4 successive post treatment observations at 30 minute intervals. $n=15$. ANOVA revealed a significant treatment effect ($F_{(1,14)}=7.7563, p<0.05$) a significant effect of time ($F_{(3,42)}=3.2885, p<0.05$) but no treatment x time interaction ($F_{(3,42)}=1.6198, n.s.$).

Results for Pain Tolerance



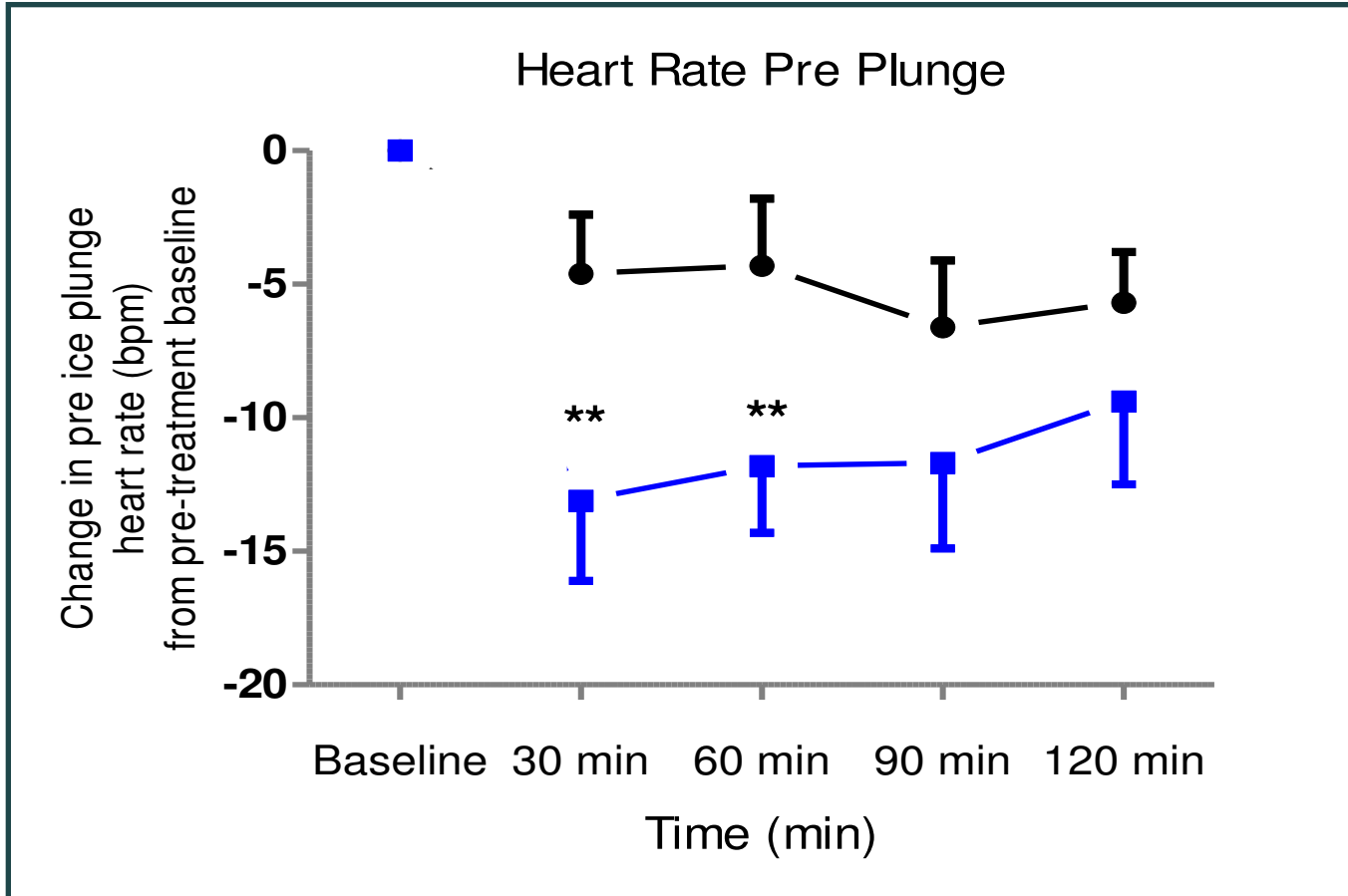
The effect of change in ice pain tolerance (s) from pre-treatment baselines, $n=15$. $p<0.01$ at 60 and 120 min, $p<0.05$ at 90 min (students t -test). Vertical lines represent \pm SEM. ●=Sham TENS (control) ■=Reflexology

Pre-plunge Heart Rate data

<i>Group</i>	<i>Pre-treatment baselines</i>	<i>Post treatment (+30 min)</i>	<i>Post treatment (+60 min)</i>	<i>Post treatment (+90 min)</i>	<i>Post treatment (+120 min)</i>
Control	78.5 ± 3.8	73.9 ± 3.4	74.2 ± 3.7	71.9 ± 3.7	72.9 ± 3.6
Reflexology	81.2 ± 3.7	68.1 ± 4.2	69.4 ± 4.0	69.5 ± 4.2	71.8 ± 3.8

Mean ± SEM for pre plunge heart rate (bpm) by group and by time showing 1 pre treatment and 4 successive post treatment observations at 30 minute intervals. $n=15$. There were no significant effects of treatment ($F_{(1,14)}=1.5749, n.s.$), time ($F_{(3,42)}=1.2608, n.s.$), or any treatment x time interactions ($F_{(3,42)}=1.4877, n.s.$)

Results of the pre-plunge Heart Rate



The effect of treatment on mean \pm SEM pre plunge heart rate (bpm) as a change from pre-treatment baselines, $n=15$. $p < 0.01$ for reflexology. Vertical lines illustrate \pm SEM.

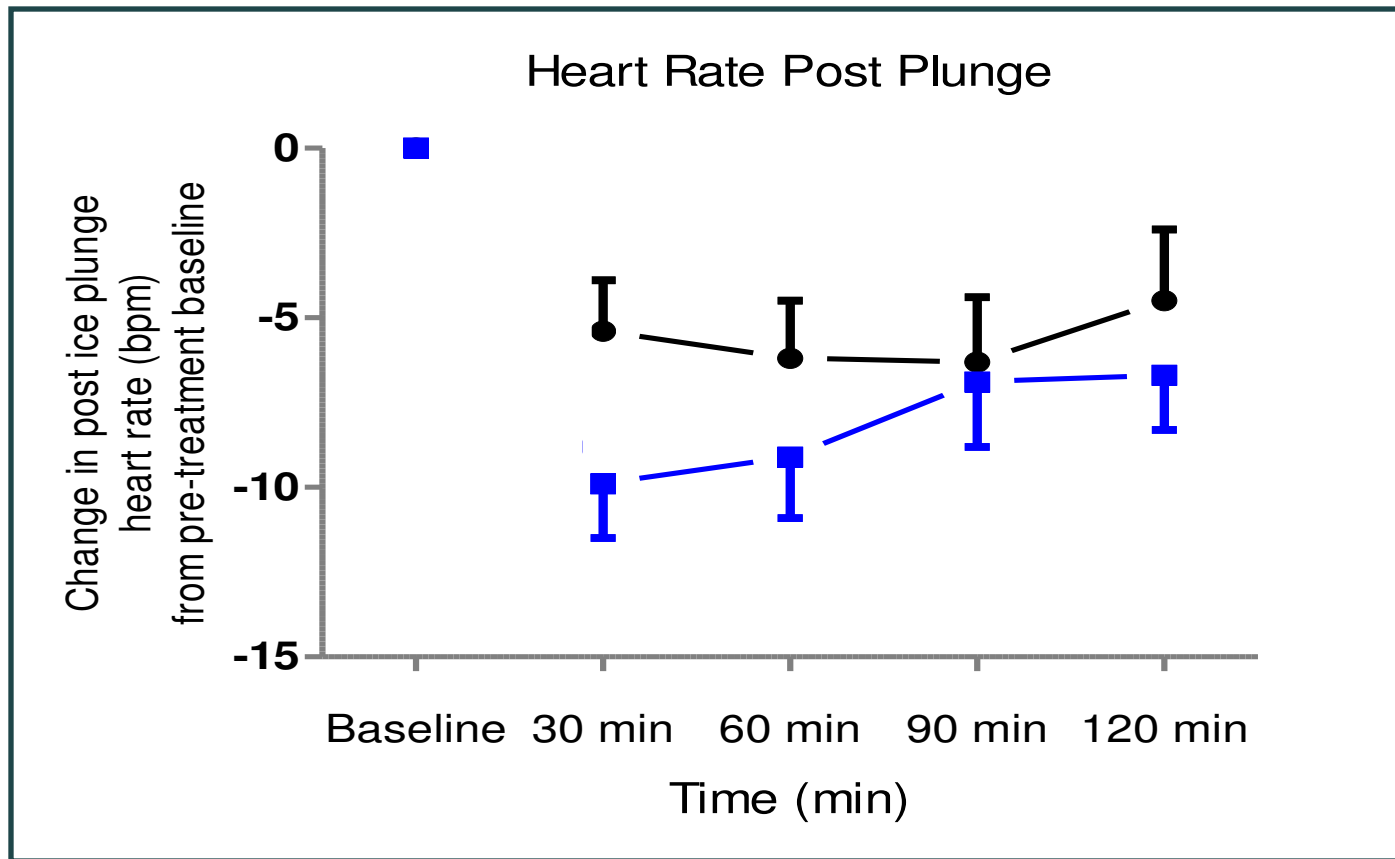
● = Sham TENS (control) ■ = Reflexology

Post-plunge Heart Rate data

<i>Group</i>	<i>Pre-treatment baselines</i>	<i>Post treatment (+30 min)</i>	<i>Post treatment (+60 min)</i>	<i>Post treatment (+90 min)</i>	<i>Post treatment (+120 min)</i>
Control	78.7 ± 3.9	73.3 ± 3.4	72.5 ± 3.3	72.5 ± 3.3	74.3 ± 3.7
Reflexology	79.7 ± 3.4	69.9 ± 3.6	70.7 ± 3.3	72.8 ± 2.8	73.1 ± 3.6

Mean ± SEM for post plunge heart rate (bpm) by group and by time showing 1 pre treatment and 4 successive post treatment observations at 30 minute intervals. $n=15$. There were no significant treatment effects ($F_{(1,14)}=0.8691, n.s.$), no significant effects of time ($F_{(3,42)}=2.6185, n.s.$) and no treatment x time interactions ($F_{(3,42)}=0.6826, n.s.$)

Results of the post-plunge Heart Rate



The effect of treatment on mean \pm SEM post plunge heart rate (bpm) as a change from the pre-treatment baselines, $n=15$. Vertical lines represent \pm SEM.

●=Sham TENS (control) ■ =Reflexology

Subjective Rating Questionnaire

- Subjective rating questionnaire used to establish perceived effect of ice immersion procedures on levels of anxiety, arousal and discomfort
- Wilcoxon sign rank test for non-parametric statistics of matched pairs showed:
- No significant differences in levels of arousal or anxiety
- Results showed significant differences in levels of discomfort between sham TENS (control) and reflexology sessions ($p < 0.05$)
- Correlates with increased effect on pain threshold and tolerance

Subjective Rating Questionnaire results

Post treatment time →	30	60	90	120
AROUSAL	0.109	0.125	0.125	0.625
ANXIETY	0.250	0.125	0.500	1.000
DISCOMFORT	0.344	0.078	0.039	0.313

The Wilcoxon signed rank test scores. Exact significance (2-tailed)

Side effects to treatment

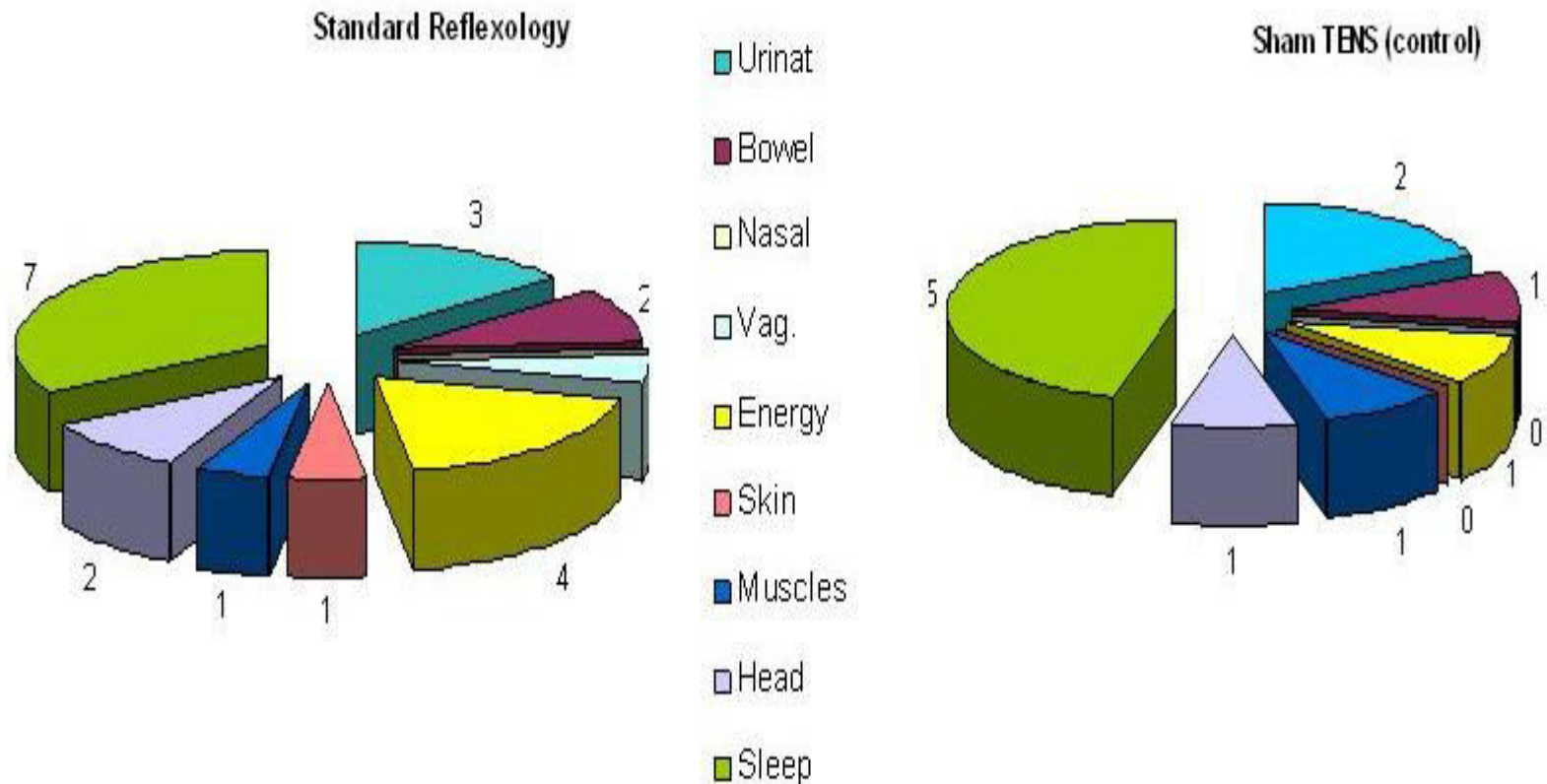


Illustration of the results of the feedback questionnaire analysis. Each section of the pie chart indicates the number of subjects experiencing side-effects of treatment. Each colour represents a different side-effect, $n=15$.

Summary of results

- Significant increase in pain threshold $p < 0.05$
- Significant increase in pain tolerance $p < 0.01$ @ 60 min, $p < 0.05$ @ 90 min and $p < 0.05$ @ 120 min
- Significant decrease in HR pre plunge $p < 0.01$ following reflexology
- No significant differences post plunge

Conclusions

- Unlikely that effect on pain threshold/tolerance is a result of sympathetic activation
- Reflexology releases endogenous neurotransmitters/neuromodulators which inhibit the transmission of pain information to the brain
- Reflexology may be useful on its own or as an adjunct to medication in the treatment of pain conditions

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It is dedicated to the late

Dr Sheelagh Campbell