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To compare the effect of different time ratio of heat and cold in contrast bath on clinical improvement in plantar fasciitis

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Abstract

Background: Contrast bath is commonly used therapy in plantar fasciitis. However there is no standard regimen followed as to the order and time ratio of hot and cold fomentation. This study was conducted to establish a standard hot: cold fomentation ratio to achieve maximum efficacy of contrast bath in plantar fasciitis.

Materials and methods: 75 patients of plantar fasciitis were equally divided into three groups, A: 3 cycles of alternate 3 minutes hot fomentation and 1 minute of cold fomentation, B: hot fomentation for 3 minutes followed by 1 minute cold fomentation followed by a sustained 12 minutes of hot fomentation and C: cold fomentation for 5 minutes followed by 2^{1/2} minutes of hot and again 5 minutes cold fomentation. Thrice daily regimen was followed. VAS score was used to note the initial pain, pain relief at 1 week and 1 month.

Results: The mean pain value in group A was 7.52±1.27 SD on initial evaluation, was 6.32±1.31 SD at 1 week and 2.8±1.42 SD at 1 month. Respective values in group B was 6.8±1.37 SD, 5.8±1.25 SD and 2.6±1.31 SD and in group C was 7.81±1.43 SD, 6.37±1.09 SD and 3.1±1.49 SD.

Discussion: In plantar fasciitis, only temperature fluctuations at subcutaneous level are required to bring a local pumping effect. This needs only alternation of hot and cold fomentation, the order of fomentation and time duration of each cycle is not specific.

Conclusion: No time ratio is superior to another.

Keywords: Hot fomentation, cold fomentation, plantar fasciitis

1. Introduction

Contrast bath is the technique of physical therapy of giving alternate hot and cold compresses to a patient in an attempt to relieve pain. The physiologic action of contrast baths is attributed to the pumping action created by alternate cold and hot fomentation. Hot water causes relaxation in the subcutaneous and intramuscular tissues while cold compresses cause contraction of these tissues creating a pumping action and increasing the vascular turnover in these tissues. This brings more nutrition and oxygen for soft tissue repair. Hence, contrast baths have commonly been adopted to relieve the symptoms associated with local inflammatory processes secondary to tissue trauma^[1] to promote soft tissue healing,^[2] and to enhance physical recovery after training and competition.^[3]

It is widely used in the multiple conditions such as carpal tunnel syndrome, tennis elbow, Achilles tendinitis, plantar fasciitis etc. A systemic review indicated that the effectiveness of contrast bath in physical recovery of such conditions is not proven.^[4] One possible factor is that one of the clinical parameters, the time ratio between hot and cold is not uniform among clinicians. In clinical practice generally a hot to cold ratio of 3:1 repeated 3-4 times a day is used.^[2, 5, 6] However there is no standard regimen followed as to the ratio of hot and cold fomentation time for the same and no reliable study has been done to establish it. Studies conducted on this subject could not definitely establish any relation between the physiologic effect and functional outcome of contrast bath. This particular study was conducted to establish a standard hot: cold fomentation ratio to achieve maximum efficacy of contrast bath in cases of plantar fasciitis.

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2. Materials and Methods

This study was conducted in the department of orthopedics in ESIC medical college and hospital, Faridabad, Haryana between June 2015 to February 2016. ESIC stands for Employee State Insurance Corporation and it insures the factory workers earning less than 15000 INR per month for their health problems. The patients coming to ESI hospitals therefore belong to low socio-economic strata. This was a prospective cohort study constituting of 75 patients. All patients with heel pain diagnosed as having plantar fasciitis were included in the study. Written and informed consent was taken from all the patients.

The diagnostic criteria for plantar fasciitis were:

1. Pain in the heel more so in the morning causing discomfort to the patient in bearing weight.
2. Tenderness in the heel pad.
3. Exclusion of all the other possible causes of pain in the heel.

The exclusion criteria from the study were:

1. Patients with known cause of plantar fasciitis such as flat foot or due to some other deformity in foot.
2. Patients who had previously received intra-lesional steroid injection.
3. Patient with known inflammatory pathology like RA, AS etc.

The patients (75 in number) were equally divided into three groups using double-blinded randomization.

Group A: an alternate 3 minutes hot fomentation for three minutes followed by 1 minute of cold fomentation followed by another 2 such cycles

Group B: hot fomentation for 3 minutes followed by 1 minute of cold fomentation followed by a sustained 12 minutes of hot fomentation. In this group a prolonged heating phase is maintained in the second cycle.

Group C: this group of people was put first on cold fomentation for 5 minutes followed by 2^{1/2} minutes of hot and then again 5 minutes of cold fomentation. In this group, fomentation brings with cold and ends in cold.

Thrice daily regimen was followed for all patients irrespective of the group the patient belonged. A compliance sheet was provided to all the subjects where they were supposed to tick in the required column after their session of contrast bath. Compliance sheet was checked at the time of follow up; patients not found compliant were excluded from the study. Apart from this, a common conservative protocol was followed for all patients that included change in shoe wear, plantar fascia and tendo-achillis stretching exercises, analgesics SOS etc. intraregional steroid were not given in any of the case.

VAS score was used to note the objective relief in the pain as observed by the patient. VAS scale was used for the following reasons:

1. VAS is sensitive to small changes than other simple descriptive ordinal scales.

2. This scale can record the changes in symptoms within the individual better than other scales.
3. Its easily understood by the patient
4. The patient himself assesses the symptoms with no bias introduced from the clinician’s side.

A 10 cm ruler was used with calibration at each mm distance providing a range of scores from 0-100. Pain recorded was the early morning pain which the patient feels during his first few steps of waking after getting up from sleep. The following findings were recorded.

1. The initial pain measurement at start of therapy measured in mm.
2. Pain relief at one week of therapy measured in mm.
3. Pain relief at one month of therapy measured in mm.

Mean, median and mode were calculated of the data recorded. Statistical comparisons between these three protocols were done using ANOVA method of statistical analysis.

3. Results

The study included 75 patients. 48 had bilateral heel pain and 27 had unilateral heel pain making a total of 123 heels with plantar fasciitis. Out of the unilateral cases, 15 had right heel pain and 12 had left heel pain. 45 patients were male and 30 were females (Table 1).

Table 1: Demonstrating the side distribution and sex distribution of the 75 patients in the study.

Demographic data	Group A	Group B	Group C
Extremity involved (right/left/bilateral)	5/3/17	7/3/15	4/5/16
Sex (male/female)	17/8	13/12	15/10

All the 45 male patients were factory workers and of the 30 females, 8 were housewives and others were factory workers. Most of them were employed in jobs involving prolonged standing such as press machine operations, security guards etc. Their job involved prolonged periods of standing without adequate periods of rest in between. The socio-economic standard of the patients was low and most of them were found to be using boots with hard sole that they wore throughout their period of work. Most of them had only one pair of boots that was used every day. Only on advice they agreed to buy soft sole shoes for their workplace.

Of the 25 patients belonging to Group A, 17 had bilateral and 8 (5 right and 3 left) had unilateral involvement making total of 42 heels. 15 patients in Group B had bilateral and 10 (7 right and 3 left) had unilateral involvement making a total of 40 heels. 16 patients in Group C had bilateral disease and 9 (4 right and 5 left) had unilateral making a total of 41 heels. Mean age of presentation in patients with Group A, B and C was 32.32, 30.76 and 33.28 years respectively. Mean duration of symptoms for the respective groups was 4.12, 3.6 and 3.92 months respectively (Table 2).

On initial evaluation, patients the mean pain value in group A was 7.52±1.27 SD, group B was 6.8±1.37 SD and in group C was 7.81±1.43 SD (Table 3).

Table 2: Demonstrates the age and duration of symptoms of patients in all age groups.

Demographic data	Group A Group B Group C					
	Mean	Median	Mean	Median	Mean	Median
Age (Years)	32.32	32	30.76	30	33.28	36
Duration of symptoms(months)	4.12	3	3.6	2	3.92	3

Table 3: Demonstrates the initial pain, pain at one week of therapy and 1 month of therapy.

	Group A			Group B			Group C			Significance
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	
Initial pain	7.52	8	1.27	6.8	8	1.37	7.81	8.5	1.43	Non-significant
Pain at 1 wk	6.32	7.5	1.31	5.8	6.0	1.25	6.37	6.5	1.09	Non-significant
Pain at 1 month	2.8	3	1.42	2.6	3.5	1.31	3.1	3.0	1.49	Non-significant

The response at 1 weeks' time was classified as relief >10 mm, <10 mm and no relief. The mean VAS score in Group A at one week was 6.32±1.31 SD, in Group B was 5.8±1.25 SD and Group C was 6.37±1.09 SD (Table 3).

In a week's time, 16 patients of group A had pain relief of >10mm, 5 patients had a relief of <10 mm and 4 patients had no relief. These values in group B were 14, 7 and 4 respectively and in group C were 17, 5 and 3 (Table 4).

Table 4: Demonstrates the number of patients with relief > 10mm, relief < 10mm and no relief after 1 week of therapy.

	Number of patients with relief > 10mm	Number of patients with relief < 10mm	Number of patients with no relief
Group A	16	5	4
Group B	14	7	4
Group C	17	5	3

One common thing noticed in the bilateral cases was that the pain relief followed a common pattern in both the heels in all parameters like amount of drop in pain at 1st week and at end of one month as well as the time taken for the relief to start.

The follow up at 1 months' time was classified as 'significant pain relief' if patient was satisfied with the treatment or if there was a drop of >30mm in measurement of pain, 'some relief' if the patient had some reduction in pain but not

accounting to <30mm of initial value and no relief if there was <10 mm of drop in pain. The mean VAS score in Group A was 2.8±1.42 SD, Group B was 2.6±1.31 SD and Group C was 3.1±1.49 SD (Table 3).

16 patients of group A had pain relief >30 mm, 5 patients had relief of 10-30 mm and 4 patients had relief < 10mm. These values in group B were 17, 6, and 2 respectively and in group C were 15, 6 and 4 respectively (Table 5).

Table 5: Demonstrates the number of patients with significant relief (depreciation of VAS score by more than 30 mm), with some relief (depreciation of VAS score between 10-30 mm) and no relief (depreciation in VAS score less than 10 mm) after 1 month of therapy.

	Number of patients with significant relief	Number of patients with some relief	Number of patients with no relief
Group A	16	5	4
Group B	17	6	2
Group C	15	6	4

Using ANOVA method of statistical analysis, the relief was comparable in all the three groups and the differences were not statistically significant.

4. Discussion

Main findings in our study were

1. Clearly, contrast bath along with simple conservative methods brings significant pain relief in the patients with plantar fasciitis.
2. No time ratio is superior to another. A prolonged sustained heating phase in second cycle (group 2) and stating the bath with cold phase and also ending it with cold phase (group 3) is as effective as the usually followed protocol of 3 hot: 1 cold for three cycles.

This study that clearly proved that contrast bath along with the other conservative methods brings significant pain relief to patients of plantar fasciitis. However this study couldn't prove the superiority of one method over another.

In a study conducted by Chiao-Yu Shih *et al* that investigated the effect of time ratio of heat to cold on brachial artery blood velocity during contrast bath found out that a prolonged hot water immersion in the second cycle of contrast baths could create an adequate fluctuation in artery blood velocity (the group 2 in our study) and they recommended '3 hot: 1 cold: 12 hot' as the time ratio.⁷ We however found no benefit clinically in keeping the hot immersion time prolonged in second cycle. A possible explanation for such an inconsistency could be that bringing fluctuations in brachial artery blood flow requires temperature at muscular level. Contrast bath brings temperature changes at such a deep level by initiating a local spinal cord reflex induced by exposure of

superficial heat, causing a decrease in postganglionic sympathetic adrenergic outflow to the smooth muscles of blood vessels, which results in vasodilatation at a deeper level.^[8] In plantar fasciitis the fluctuations at subcutaneous level is all that is required to bring a local pumping effect. Creation of such a local pump can be probably needs only an alternate hot and cold fomentation. A sustained heating period may not be needed. Also the study by Chiao-Yu Shih *et al* saw the alterations in brachial artery blood flow and not the clinical outcome in the patients.^[7]

Starting the fomentation with cold water and ending it in cold water and keeping the cold fomentation time more than the hot fomentation time (group 3) may appear sensible because plantar fasciitis is a local inflammatory process. However the clinical effect of this protocol is similar to the other two. It appears that starting the procedure with either hot or cold and then alternating it with the opposite modality doesn't make a difference to the creation of a 'local pump.'

It must be mentioned that the findings in this study were limited by the small sample size. Also it is not possible to isolate the magnitude of pain relief brought about by contrast bath alone. The confounding factors like shoe wear modifications, exercises and analgesics are difficult to isolate. Further studies and research in this field are required to validate the findings in this study.

5. Conclusions

Contrast bath should be recommended in all patients with plantar fasciitis. No specific time ratio is recommended and patient may choose it according to his convenience.

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