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Acetic Acid Iontophoroesis Vs Ultrasound Therapy Combined with High Heel usage in Heel Pain Patients

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Abstract: ***Background: A small part of our body, Heel is bearing the entire body weight and also helping in transfers. For this function to be carried out without any difficulty or discomfort, it demands multiple factors to be in proper alignment, good strength, coordinated and to be fit enough with all its properties. Under uneven conditions it may undergo suffering. Ten percent of these people experiencing pain under the heel (plantar heel pain) are approaching or else referred to physiotherapy clinics. Injections, insoles, heel pads, strapping and surgery have been common forms of treatment given. With the wide intervention options available for treating this condition, there is always a doubt in finding out the best. The absolute and relative effectiveness of these interventions are not understood clearly in individuals with heel pain. Objective: The aim of this prospective study was to compare Acetic Acid Iontophoroesis (AAI) treatment with that of Ultrasound therapy along with high heel usage (USHH) on heel pain and functional outcomes.***

Keywords: Acetic Acid Iontophoroesis (AAI), Ultrasound therapy along with high heel usage (USHH), Foot and Ankle Ability Measure (FAAM)

1. Introduction

With respect to pain generation, current literature focuses beyond radiographic evidence of pathological calcified or ossified structures and places a greater emphasis on the physiological events that precedes this process.[4]
Histopathologic changes of patients who have chronic heel pain include an initial low-grade periosteal inflammation, edema, fibroblastic and inflammatory cell proliferation.[2]

Calcium deposits infiltrate inflamed, dead, or dying tissue despite normal blood calcium levels and normal calcium metabolism.[1]

One theory proposes that denatured proteins from damaged cells unmask reactive groups that bind with phosphate radicals that attract and bond with calcium ions, which in turn, open collagen bundles causing tissue swelling, fat saponification and further tissue disruption.[5]

Consequently, these calcium ions break protein cross-linkages with polyaminoglycans like chondroitinsulfate disrupting other protein linkages.[6]

The continual progression of chronic tissue inflammation due to abnormal stress progresses from a physiological reaction to fibrocartilagenous tissue formation leading to cartilage deposition and eventual bone spur development.[4]

Shama and Kominsky noted that of 1, 000 patients who had been radiographed, only 132 had evident heel spurs of which, only 39% complained of a history of heel pain.[4, 6] Thus, it could be reasoned that bone spurs are the long-term pathological response to maladaptive tissue dysfunction and that the deposition of dystrophic calcium that occurs prior to osseous formation is the primary focus of chronic pain generation.

2. Treatment

Le Duc first described Iontophoresis in 1908 as a way to repel ions through the skin using a direct current.

Acetic acid has a negative ionic polarity so it was added to the delivering pad which was connected with the negative (cathode-black) electrode to repel the acetic acid ions through the skin into the underlying tissue. The buffering pad was placed just above the treatment area over the Achilles tendon and was connected to the positive (anode-red) electrode.[4]

Treatment using acetic acid iontophoresis had been previously indicated in treating conditions such as myositisossificans, calcific bursitis and calcific tendonitis.[12] Iontophoresis has been suggested as an alternative to local corticosteroid injections.[15]

The rationale for treatment would primarily aim at increasing the solubility of calcium deposits in tendons and soft tissuesto encourage the removal of excess calcium ions from the injury site into the blood stream. [4] Japour et al. describes in detail the theoretical biochemical process where the use of acetic acid iontophoresis converts insoluble calcium carbonate in chronically inflamed tissue to calcium acetate, which is blood-soluble.[11] Pulsed Ultrasound was used to reduce inflammation, perfuse local blood flow and facilitate the removal of the newly formed calcium acetate into the blood and thereby remove it from the localized area of heel pain.

3. Methods

36 cases of heel pain patients have been identified from outpatient departments, PT clinics, gyms, general and Orthopaedic hospitals. They were allocated into 2 groups.

In the AAI group (n = 18), patients received AAI.For this patient shall lie in prone lying, then put the drug on the dispenser pad (negative electrode), and apply the pad over Achilles tendon. Another pad (positive electrode) shall be placed away from the ground.

In the USHH group (n =18), patients received the Ultrasound therapy program along with the advise to wear high heels.
The evaluation parameter is FAAM scale with ADL and Sport scores. Patient has to complete the Foot and Ankle Ability Measure scale prior to and after the Iontophoresis therapy and USHH.

3.1 Parameters

Iontophoresis
With Iontophoresis therapy of 4% acetic acid using Digistim (HMS) multimodal machine at a setting of 2.0 mA DC, current for 20 min, the positive electrode (anode) was overlying the skin on the Achilles tendon, and the negative electrode (cathode) placed over the calcaneum (heel).

Machine- Digistim (HMS-multimodal, mains voltage 90-270V, Output 0-50mA, Time 0-60 min)
Solution - Acetic acid (4-5%)
Dosage - 4ml
Intensity – 2mA
Current Density – 0.5mA/sq cm at negative, 1.0mA/sq cm at positive electrode
Session Duration- 20min
Total Treatment Time: 6 times/week, for 3 weeks, Total sessions: 18

Ultrasound
Ultrasound (20%)
Machine: 3.3MHz
Intensity: 2.0W/cm^2
Pulse Ratio: 1:4
Total Treatment Time: 6 times/week, for 3 weeks, Total sessions: 18

High-Heel
Height of Heel: only 8mm (as 6-10mm higher than normal is preferable) [10, 13, 14]

Foot and Ankle Ability Measure (FAAM)
The FAAM is a patient-completed instrument that consists of an "Activities of Daily Living" subscale (21 scored items) and a "Sports" subscale (7 scored items) in which the response options are presented as 5-point Likert scales (range 4 to 0). Scores for each subscale range from 0% (least function) to 100% (most function).[6, 16]

The Foot and Ankle Ability Measure (FAAM) is a self-report outcome instrument developed to assess physical function for individuals with foot and ankle related impairments.[6, 16]

The Foot and Ankle Ability Measure is a 28-item questionnaire divided into two subscales:

The Foot and Ankle Ability Measure, 21-item Activities of Daily Living Subscale and
1) Standing
2) Walking on even ground
3) Walking on even ground without shoes
4) Walking up hills
5) Walking down hills
6) Going up stairs
7) Going down stairs
8) Walking on uneven ground
9) Stepping up and down curbs
10) Squatting
11) Coming up on your toes
12) Walking initially
13) Walking 5 minutes or less
14) Walking approximately 10 minutes
15) Walking 15 minutes or more
16) Home responsibilities
17) Activities of daily living
18) Personal care
19) Light to moderate work (standing and walking)
20) Heavy work(push/pulling, climbing, carrying)
21) Recreational activities

The Foot and Ankle Ability Measure, 7-item Sports Subscale. The Sports subscale assesses more difficult tasks that are essential to sport, it is a population-specific subscale designed for athletes.

1) Running
2) Jumping
3) Landing
4) Startingand stopping quickly
5) Cutting/lateral movements
6) Ability to perform activity with your normal technique
7) Ability to participate in your desired sport as long as you would like

Prior / After to Treatment:
Because of your foot and ankle how much difficulty do you have with?

Please answer every question with one response that most closely describes your condition within the past week. If the activity in the question is limited by something other than your foot/ankle, then mark it as N/A.

Reference for Score:

	No difficulty	Slight difficulty	Moderate difficulty	Extreme difficulty	Unable to do	N/A
Home Responsibilities						
Activities of Daily Living						
Personal Care						
Light to Moderate work (standing, walking)						
Heavy work (Push / pull, climbing, carrying)						
Recreational Activities						

How would you rate your current level of function during your usual activities of daily living from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities.

4. Results

AAI- Acetic Acid Iontophoresis

	ADL Score%	
	prior	After
1	53.57	61.90
2	52.38	64.28
3	59.52	76.19
4	67.85	76.19
5	71.43	88.09
6	83.33	95.23
7	69.05	85.71
8	76.10	85.71
9	54.76	73.80
10	67.85	71.43
11	70.24	89.28
12	78.57	89.28
13	71.43	88.09
14	73.80	85.71
15	85.71	83.33
16	77.38	80.95
17	66.66	80.95
18	69.05	83.33

	Sports Score%	
	prior	after
1	21.48	57.14
2	17.85	42.85
3	14.28	78.57
4	17.88	75.00
5	21.48	78.57
6	14.28	92.85
7	17.88	78.57
8	21.48	85.71
9	14.28	64.28
10	14.28	57.14
11	14.28	85.71
12	17.88	85.71
13	17.88	78.57
14	17.88	78.57
15	21.48	78.57
16	21.48	71.43
17	21.48	64.28
18	14.28	78.57

USHH – Ultrasound With High Heel

	ADL Score%	
	Prior	after
1	57.14	71..42
2	57.14	76.19
3	59.52	76.19
4	61.90	71.42
5	64.28	80.95
6	50.00	78.57
7	52.38	71.42
8	64.28	85.71
9	83.33	92.85
10	73.80	83.33
11	76.19	88.09
12	64.28	80.95
13	80.95	92.85
14	85.71	95.23
15	61.90	90.47
16	54.76	78.57
17	57.14	85.71
18	59.52	88.09

	SPORTS Score%	
	Prior	After
1	21.42	50.00
2	21.42	57.14
3	17.85	50.00
4	21.42	71.42
5	17.85	78.57
6	21.42	85.71
7	17.85	85.71
8	21.42	71.42
9	14.28	57.14
10	14.28	50.00
11	20.57	78.57
12	21.42	85.71
13	21.42	78.57
14	17.85	71.42
15	17.85	71.42
16	42.85	64.28
17	21.42	85.71
18	17.85	50.00

Paired t Test

AAI – ADL Score	N	Mean	Std. Deviation	SEM
Pre	18	69.37	9.536	2.248
Post	18	81.08	8.916	2.102
Difference		-11.71	5.831	1.374

95% confidence interval for difference: -14.61 to -8.81
t = -8.520 with 17 degree of freedom; P = 0.000

AAI – SPORT Score	N	Mean	Std. Deviation	SEM
Pre	18	21.25	14.61	3.443
Post	18	74.01	12.48	2.942
Difference		-52.76	17.16	4.046

95% confidence interval for difference: -61.29 to -44.22
t = -13.040 with 17 degree of freedom; P = 0.000

USHH – ADL Score	N	Mean	Std. Deviation	SEM
Pre	18	64.68	10.78	2.541
Post	18	82.67	7.695	1.814
Difference		-17.99	7.177	1.692

95% confidence interval for difference: -21.56 to -14.42
t = -10.634 with 17 degree of freedom; P = 0.000

USHH – SPORT Score	N	Mean	Std. Deviation	SEM
Pre	18	20.58	6.067	1.43
Post	18	69.04	13.64	3.215
Difference		-48.46	14.38	3.39

95% confidence interval for difference: -55.62 to -41.31
t= -14.298 with 17 degree of freedom; P = 0.000

Unpaired t Test (AAI vs USHH ADL post scores):
t-score: 0.5715
standard error of difference: 2.7761
degrees of freedom: 34
2 tailed p – Value: 0.5676
Confidence interval: 95%
Mean difference: - 1.5867
Confidence range: -7.2554 to -4.0821

Unpaired t Test (AAI vs USHH SPORT post scores):
t-score: 1.1385
standard error of difference: 4.3577
degrees of freedom: 34
2 tailed p – Value: 0.5099
Confidence interval: 95%
Mean difference: 4.9611
Confidence range: -3.9374 to -13.8596

5. Conclusion

Heel Pain is a common condition that can be effectively treated by conservative interventions. The results of this study demonstrate that the integrative use of high heels in combination with ultrasound, is more effective than the acetic acid iontophoresis. The use of combo therapies is required to resolve the effects of tissue adaptation due to chronic inflammation while improving musculoskeletal abnormalities and biomechanical imbalances. This integrative approach in the conservative management of heel pain has resulted in the resolution of symptoms and a high degree of patient satisfaction with treatment.
US combined with HH have produced better improvement than AAI on FAAM scale in heel pain patients.

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