

EFFECTIVENESS OF ACETIC ACID IONTOPHORESIS AND ULTRASOUND THERAPY ON CALCANEAL SPUR- A CASE STUDY

EFICIENȚA IONTOFOREZEI CU ACID ACETIC ȘI A ULTRASUNETULUI ÎN TRATAMENTUL PINTENULUI CALCANEAN - STUDIU DE CAZ -

Nitin S. Nikhade¹, Snehal Waghavkar²

Key Words: Acetic acid, Calcaneal spur, Iontophoresis, Ultrasound

Cuvinte cheie: acid acetic, pinten calcanean, iontoforeză, ultrasunet

Abstract

Background. The acetate ion found in acetic acid iontophoresis has been cited as effective in reducing the size of calcium deposits through the absorption of calcium and the ultrasound possibly disperses the acetic acid into the underlying tissue.

The purpose of this case report was to document the treatment of a patient who had calcaneal spur on left side with acetic acid iontophoresis followed by ultrasound.

Method. A 29 year old lady developed calcaneal spur on left side. A 5% acetic acid solution was administered via iontophoresis into the left side calcaneal spur, followed by 8 minutes of pulsed ultrasound at 1.5W/cm². Exercises like non-weight bearing stretches for plantar fascia and Achilles tendon were given daily along with over the counter soft insole. Proprioceptive exercises and resisted exercises with theraband for ankle were given progressively. The treatment was performed 3-5 times per week for 6 weeks. The primary outcome measure was the degree of radiographic calcification by using Mediff Insta Rad Viewer software.

Results. At the conclusion of the treatments, radiographic findings indicated 85% decrease in the size of the calcaneal spur. The pain decreased by 100% of its initial intensity on completion of the treatment.

Conclusion. This case report demonstrates the potential for a therapeutic program of acetic acid iontophoresis and ultrasound in reducing calcaneal spur.

Rezumat

Introducere. Ionii de acetat rezultați din iontoforeza cu acid acetic s-au dovedit a fi eficienți în reducerea mărimii depozitelor de calciu, datorită absorbției calciului, în vreme ce ultrasunetul ajută la dispersarea acidului acetic în țesuturile vizate.

Scopul acestui studiu de caz este documentarea tratamentului unui pacient cu pinten calcanean la piciorul stâng, cu ajutorul iontoforezei cu acid acetic urmat de ultrasunet.

Metodă. O pacientă de 29 de ani cu pinten calcanean la piciorul stâng. S-a administrat o soluție de 5% acid acetic prin iontoforeză efectuată la nivelul calcaneului stâng, urmată de 8 minute de ultrasunet pulsant, la 1.5W/cm². Exerciții precum stretchingul fără încărcare, pentru fascia plantară și tendonul lui Achile s-au efectuat zilnic, concomitent cu purtarea în pantof a unui brant moale. S-au introdus progresiv exerciții proprioceptive și cu rezistență, cu bandă elastică, pentru gleznă. Tratamentul s-a efectuat de 3-5 ori pe săptămână, timp de 6 săptămâni. Evaluarea s-a realizat prin urmărirea radiografică a gradului de calcifiere, cu ajutorul Mediff Insta Rad Viewer software.

Rezultate. La terminarea tratamentului, rezultatul radiologic a indicat o reducere de 85% a pintenului calcanean. Durerea s-a redus 100% față de faza inițială.

Concluzii. Acest studiu de caz demonstrează potențialul unui program terapeutic constând în iontoforeză cu acid acetic urmat de ultrasunet, în reducerea pintenului calcanean.

¹ Associate Professor, PDVVPF's College of Physiotherapy, Ahmednagar, Maharashtra State, India

Corresponding author. Address: PDVVPF's College of Physiotherapy, Opp. Govt. Milk Dairy, Vilad ghat, Ahmednagar, Maharashtra State, India. 414111, Phone no.: +919890541906
E-mail id: nikhadenitin@yahoo.com

² Physiotherapist, PDVVPF's College of Physiotherapy, Ahmednagar, Maharashtra State, India

Introduction

Iontophoresis is the introduction of topically applied, physiologically active ions through the epidermis using continuous direct current. Described initially by Le Duc in 1908, iontophoresis is based on the principle that an electrical charge will repel a similarly charged ion. [1] The spur is thought to be a result of the biomechanical fault and an incidental finding when associated with the painful plantar heel. [2,4] Studies have shown that from 10-58% of patients with a painful plantar heel actually demonstrated an inferior calcaneal spur. [3,4]

The clinical use of acetic acid iontophoresis in the treatment of patients with calcium deposits was first described in 1955 by Psaki and Carroll [5], and again in 1977 by Kahn [6]. The use of acetic acid iontophoresis (with and without ultrasound therapy) has been investigated in other calcific conditions including calcifying shoulder tendonitis. [7,8]

A case report published in 1992 described an almost complete resolution of traumatic myositis ossificans with acetic acid iontophoresis followed by ultrasound. [9] The rationale behind using acetic acid iontophoresis in the treatment of calcific lesions is that it is thought that the acetate ion replaces the carbonate ion in the insoluble calcium carbonate deposit, forming a more soluble compound, calcium acetate. [10] The ultrasound possibly disperses the acetic acid, though there have been studies using ultrasound therapy on its own for treatment of calcific deposits. [11]

Objective

Our aim was to investigate whether acetic acid iontophoresis followed by ultrasound reduce the size of heel spur without adverse effects.

CASE REPORT

History

A 29 years lady came with chief complaint of pain in left heel since 8 months with inability to bear complete weight on left heel. Her symptoms initially began insidiously 8 months ago and were gradually worsening. She reported that she had previous episodes of heel pain in the past but it would spontaneously resolve after 1–2 days of rest. She was taking pain killers for same problem since six months but she found no relief. At that point, she was evaluated by orthopedician and referred for x-ray. X-ray revealed remarkable heel spur on left side. She was then referred to Dept. of Physiotherapy, PDVVPF's Medical College and Hospital, Ahmednagar.

Pain history

Site: Over the left heel

Onset: Gradual

Duration: 8 months

Quality: Deep throbbing

Quantity: (VAS Score)

0-----7-----10

Aggravating factors: Prolonged standing, walking, stair climbing.

Relieving factors: supine lying and high sitting.

Physical Examination

Patient was examined thoroughly by the therapist.

- Point tenderness (grade-2) over the medial calcaneal tubercle.
- Standing posture evaluation revealed generally good alignment in the lumbopelvic region. She had pes planus with mild calcaneal eversion bilaterally but more on left side foot.
- Gait assessment revealed prominent forefoot pronation with mild foot flaring laterally on left side.
- Leg length comparisons were within normal limits.

- The following orthopedic tests were negative: Anterior and posterior drawer, Talar tilt, Kleiger's, Thompson's, Homan's, Noble's compression and Hibb's.

Investigations

X-ray revealed a 9 x 5 mm inferior calcaneal spur at the left side calcaneum.

Methodology

The Institutional Research Ethical Committee approval was taken to carry out this case study and then informed consent was obtained from the patient. Therapist discussed the treatment plan with physician and orthopedician. In an attempt to decrease the size and possible progression of the calcaneal spur, acetic acid iontophoresis was chosen to supplement orthopedic surgeons prescription of analgesic tablet (tab Diclo-MR) initially.

Treatment Procedure

The acetic acid iontophoresis treatments were delivered using the Phyaaction Guidance-E (Uniphy) System with 5 ml of 5% acetic acid solution, using distilled water as dilution medium.

The acetic acid solution was added to the delivering pad which was connected with the negative-active (cathode-black) electrode and was placed over the site of calcaneal spur on left heel. Acetic acid has a negative ionic polarity so when it is connected to negative electrode, it repel the acetic acid ions through the skin into the underlying tissue.

The buffering pad was connected to the positive-inactive (anode-red) electrode and was placed approximately 10 cm proximal to the active electrode, just above the treatment area over the Achilles tendon. The patient was treated with 4 mA of direct current for 20 min for a total of 80 mA.min dosage, in accordance with sharp protocol. [12] Immediately after each acetic acid iontophoresis, the patient received 1 MHz pulsed ultrasound (50% duty cycle) at $1.5\text{W}/\text{cm}^2$ for 8 minutes [13,14,15] using ultrasonic coupling gel as the transmission medium. The frequency of treatment was 5 times per week for first 3 weeks and then 3 times per week for next 3 weeks. X-ray was repeated after 3rd week and after 6th week to see whether any change occurs in the shape of the spur.

Exercises

Exercises like non-weight bearing stretches utilizing 2 sets of 5 repetitions with 20–30 seconds hold for plantar fascia and Achilles tendon were given daily along with over the counter soft insole. [16,17] Exercises for ankle inversion/eversion and dorsiflexion/ plantarflexion were performed and progressed from red to green to blue therabands at a frequency of 3 times per week with 2–3 sets of 15–20 repetitions. [18,19,20] Proprioceptive exercises were progressed from 1 leg standing with eyes open to eyes closed and then standing on wobble board exercises[14].

Outcome measures / image acquisition:

The primary outcome measure was the degree of radiographic calcification. Secondary endpoints were patients pain score on VAS and physician opinion. The radiograph was taken at baseline and at 3 weeks (after the fifteenth treatment session) and at 6 weeks (after the twenty-fourth treatment session). Lateral views were acquired of the area of calcification. Fixed radiographic parameters were used each time while taking X-ray.

Image analysis:

All images were digitized by using Mediff InstaRad Viewer software. The images were then cropped to the required region of interest (Fig.1 & 2).



Fig-1: Heel spur before treatment



Fig-2: Heel spur after 6 weeks treatment

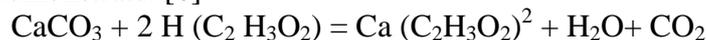
Result

The radiographic findings after 6 weeks of treatment indicated 85% decrease in the size of the calcaneal spur. The pain decreased by 100% of its initial intensity on VAS scale at completion of the treatment and the patient was able to return to pain free daily activities.

Discussion

In the foot, the pull of the plantar fascia, especially during excessive pronation, has been implicated as the etiologic factor for the development of the calcaneal spur. [2,3,21] The exact mechanisms of the origin and of resorption of the calcium deposits are not clearly understood. [22]

Treatment using acetic acid Iontophoresis had been previously indicated in treating conditions such as myositis ossificans [9], calcifying tendinitis [7,8] and calcific bursitis. [23] The rationale of treatment was primarily to aim at increasing the solubility of calcium deposits in tendons of soft tissues to encourage the removal of excess calcium ions from injury site into the blood stream. [6,7,8,22] The acetate ion found in acetic acid is negative in polarity and has been cited as effective in reducing the size of calcium deposits through the absorption of calcium.[5] The process by which iontophoresis occurs relies much more on the laws of passive diffusion [24]. It has been postulated that the acetate radical replaces the carbonate radical in the insoluble calcium carbonate deposits, forming a more soluble calcium acetate, as the following equation demonstrate. [6]



Japour et al described in details the theoretical biomechanical process where the use of acetic acid iontophoresis converts insoluble calcium carbonate in chronically inflamed tissue to calcium acetate which is then able to dissolve within local blood circulation and be removed from the site of injury. [6,10]

In this study, initial radiograph revealed calcific mass to be 9 mm in length and 5 mm in width. After 3 weeks, pain in heel was reduced to greater extent (2 on VAS scale) and X-Ray showed considerable reduction in calcific mass. At the end of six week the calcific mass reduced to 3 mm in length and 1.5 mm in width which is almost 85% of its original size. Pain was reduced from 7 to 0 out of 10 on VAS scale and previously painful activities were found painless. What caused the reabsorption of the calcaneal spur in this patient is unknown. Ultrasound may have enhanced the resorption of the soluble calcium acetate. It is also questionable whether the ultrasound treatment itself played a role in the resolution of the spur. It has been inconclusively argued in the literature as to whether bone reabsorption or formation is enhanced by ultrasound. [11,23,25] Therefore, properly controlled studies are necessary to determine the efficacy of the individual entities of the treatment program chosen.

Conclusion

The result of this study demonstrated that the integrative use of acetic acid iontophoresis in combination with ultrasound and exercises are effective treatment approach to resolve calcaneal spur and associated symptoms within six weeks of treatment.

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References

- [1] Cummings J, Iontophoresis. In: Nelson RM, Currier DP, eds. (1987), *Clinical Electrotherapy*. East Norwalk, Conn: Appleton & Lange;:231.
- [2] DuVries HL (1959), *Surgery of the Foot*, Ed 4, pp 287-291. St Louis: CV Mosby Co,
- [3] Bateman JE: The adult heel. In: Jahss MH (ed), (1982), *Disorders of the Foot*, Vol 1, Ch 27. Philadelphia: WB Saunders,
- [4] Furey JG (1975), Plantar fasciitis: the painful heel syndrome. *J Bone Joint Surg (Am)* 57:672-673,
- [5] Psaki CG, Carroll J. (1955), Acetic acid ionization: a study to determine the absorptive effects upon calcified tendinitis of the shoulder. *Phys Ther Rev.* ;35:8447.
- [6] Kahn J. (1977), Acetic acid iontophoresis for calcium deposits: suggestion from the field. *Phys Ther.*; 57:658-660.
- [7] Perron M, Malouin (1997), F. Acetic acid iontophoresis and ultrasound for the treatment of calcifying tendinitis of the shoulder: a randomized control trial. *Arch Phys Med Rehab*; 78:379-84.
- [8] Leduc BE, Caya J, Tremblay S, Bureau NJ, Dumont M. (2003), Treatment of calcifying tendinitis of the shoulder by acetic acid iontophoresis: a double-blind randomized controlled trial. *Arch Phys Med Rehabil*; 84:1523-27.
- [9] Wieder D. (1992), Treatment of traumatic myositis ossificans with acetic acid iontophoresis. *Phys Ther*;72:133-37.
- [10] Kahn J. (1987), Principles and Practice of Electrotherapy. New York, Churchill Livingstone;.
- [11] Ebenbichler GR, Erdogmus CB, Resch KL et al. (1999), Ultrasound therapy for calcific tendinitis of the shoulder. *N Engl J Med*; 340:1533-38.
- [12] Sharp N. (1988), Acetic acid: a solution for some frozen shoulders. *Phores or Forum.*;7(5):1.
- [13] S. Shetty, T. L. Moore, S. Jackson¹, D. Brett² and A. L. Herrick, (2005), A pilot study of acetic acid iontophoresis and ultrasound in the treatment of systemic sclerosis-related calcinosis. *Rheumatology*; 44:536-538
- [14] Ivano A Costa, Anita Dyson (2007), The integration of acetic acid iontophoresis, orthotic therapy and physical rehabilitation for chronic plantar fasciitis: a case study, *J Can Chiropr Assoc*; 51(3):166-174
- [15] Fay Crawford, Michael Snaith (1996), How effective is therapeutic ultrasound in the treatment of heel pain? *Annals of the Rheumatic Diseases*; 55: 265-267
- [16] Kent Stuber & Kevyn Kristmanson, (2006), Conservative therapy for plantar fasciitis. *Jr Can Chiropr Assoc.*; 50 (2): 118-133.
- [17] DiGiovanni BF et al. (2003), Tissue-specific plantar fascia stretching exercise enhances outcomes in patients with chronic heel pain: a prospective, randomized study. *J Bone Joint Surg*; 85A(7):1270-1277.
- [18] Edmund M. Kosmahl, Herbert E. Kosmahl (1987), Painful Plantar Heel, Plantar Fasciitis, and Calcaneal spur: Etiology and Treatment. *JOSPT* July Vol. 9, No. 1: 17-24.
- [19] James L. Thomas, Jeffrey C. Christensen, Steven R. Kravitz (2010) The Diagnosis and Treatment of Heel Pain: A Clinical Practice Guideline-Revision, *2010 Journal of Foot & Ankle Surgery* 49 S1-S19
- [20] Charles Cole, M.D., Craig Seto, M.D., and John Gazewood (2005), Plantar Fasciitis: Evidence Based Review of Diagnosis and Therapy. *Am Fam Physician*; 72:2237-42, 2247-48.
- [21] Duggar GE: Plantar fasciitis and heel spurs. In: McGraw ED (ed), (1974), *Reconstructive Surgery of the foot and Leg*, pp 67-73, New York: Intercontinental Medical Book Co,
- [22] JS Sarkar. FS Haddad. SV Crean. P. (1996), Brooks from Lister Hospital. Stevenage. England. Acute calcific tendinitis of the rectus femoris, *Journal-Bone Joint Surgery Br*, 78-B, 814-816.
- [23] Cline PD. (1963) Radiographic follow up of ultrasound therapy in calcific bursitis: case report. *Phys Ther.*;43:659-660.
- [24] Prentice, WE (2002). *Therapeutic Modalities for Physical Therapists* (2nd edition). McGraw-Hill: New York.
- [25] Ziskin MC, Michlovitz SL. Therapeutic ultrasound. In: Michlovitz SL, ed. (1986), *Thermal Agents in Rehabilitation*. Philadelphia, Pa: FA Davis Co;:160.