

# Iontoforese com Ácido Acético no Tratamento da Tendinite Calcificante do Ombro

## *Acetic Acid Iontophoresis in the Treatment of Calcifying Tendinitis of the Shoulder*

Moisés Henriques<sup>(1)</sup> | Ricardo Henriques<sup>(2)</sup>

### Resumo

O objectivo deste caso clínico é evidenciar o papel da iontoforese com ácido acético no tratamento da tendinite calcificante do ombro. A tendinite calcificante é uma patologia comum, especialmente no ombro, embora na maioria dos casos seja assintomática.

O tratamento de depósitos de cálcio com iontoforese com ácido acético foi descrito pela primeira vez em 1955. Acredita-se que o ião acetato substitua o ião insolúvel de carbonato de cálcio na calcificação, formando um composto mais solúvel. Posto isto, é razoável esperar uma regressão da calcificação.

A utilização da iontoforese com ácido acético é predominantemente empírica, provavelmente porque é relativamente barata e segura. Apesar de todas as dúvidas existentes sobre a eficácia da iontoforese com ácido acético no tratamento da tendinite calcificante do ombro, este caso clínico parece ser outro exemplo de sucesso terapêutico.

**Palavras-chave:** Iontoforese, Tendinopatia, Calcificação Fisiológica.

### Abstract

*The purpose of this case report is to highlight the role of acetic acid iontophoresis in the treatment of calcifying tendinitis of the shoulder. Calcifying tendinitis is a common disorder and it is most common around the shoulder joint, despite most cases being asymptomatic.*

*The clinical use of acetic acid iontophoresis in the treatment of patients with calcium deposits was first described in 1955. It is thought that the acetic ion replaces the carbonate ion in the insoluble calcium carbonate deposit, forming a more soluble compound. Therefore, it is reasonable to expect a regression of the calcification.*

*The use of therapeutic acid acetic iontophoresis is predominantly empirical, probably because it is relatively inexpensive and safe. Despite all doubts regarding the effectiveness of acetic acid iontophoresis on the treatment of calcifying tendinitis of the shoulder, this case report appears to be another example of therapeutic success.*

**Keywords:** Iontophoresis; Calcification, Physiologic; Shoulder Joint; Tendinopathy.

(1) Médico Naval, Centro de Educação Física da Armada, Almada, Portugal; Médico Interno de Medicina Física e de Reabilitação, Centro Hospitalar Lisboa Norte - Hospital de Santa Maria, Lisboa, Portugal.

(2) Assistente Hospitalar de Medicina Física e de Reabilitação, Centro Hospitalar Lisboa Norte - Hospital de Santa Maria, Lisboa, Portugal.

E-mail: salvodasaguas@gmail.com

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## Introduction

Calcifying tendinitis is a common disorder and it can affect almost any tendon.<sup>1</sup> It is most common around the shoulder joint and is characterized by a reactive calcification (composed mainly by hydroxyapatite crystals) that affects the rotator-cuff tendons.<sup>1,2</sup>

Calcifying tendinitis of the shoulder has a reported incidence of 3 to 20 percent despite most cases being asymptomatic - incidental radiographic findings.<sup>2,3</sup> Clinical symptoms (shoulder pain with acute or chronic painful restrictions of the shoulders range of motion and thus limitation of the activities of daily living) occur in from 34% to 45% of patients with calcifying tendinitis.<sup>1,2</sup>

Treatments directed toward the calcium deposits, such as surgery and percutaneous needle aspiration, seem to reduce pain and restore shoulder function in some, but not all, patients.<sup>1,2</sup> Surgery carries a risk of operative complications and arthroscopic procedures fail about half the time.<sup>2,4</sup> Percutaneous needle aspiration alleviates symptoms in up to 60 percent of patients and resolves the deposits in 40 to 60 percent.<sup>2,4</sup> Promising results have been reported for extracorporeal shock wave therapy, which is a non-invasive option of treatment for calcifying tendinitis.<sup>2</sup> It has a 70 percent of success rate and reportedly disintegrated calcium deposits partially or completely in almost two thirds of patients and induced clinical improvement in three quarters of patients.<sup>2,4</sup> The procedure can be painful and it can cause minor skin bruising, reddening, swelling around the treated area and pain immediately following the procedure - many of these side effects often go away after a short period of time. This treatment is still very expensive and is not available in all hospitals.

The acetate ion found in acetic acid has been cited as effective in reducing the size of calcium deposits through the absorption of calcium. The purpose of this case report is to highlight the role of acetic acid iontophoresis in the treatment of calcifying tendinitis of the shoulder.

## Case Report

51-year-old male, caucasian, construction worker and independent in activities of daily living. The patient had no known relevant family history. From the personal history was noted: bilateral shoulder pain with about two years of evolution (right shoulder: infiltration with corticosteroids in 2006; left shoulder: infiltration with corticosteroids in 2007 and 2008.11.27 - all cases by posterior approach), osteo-degenerative joint disease, low back pain, lumbar scoliosis and vocal cords surgery. The patient was followed in

Orthopaedic, Rheumatology and Otorhinolaryngology consultation.

This patient was first observed in the Physical and Rehabilitation Medicine consultation (2008.12.17) due to chronic left shoulder pain with functional impairment according to the orthopaedic referral. At this time, the patient reported left shoulder pain (score of 6 on the numerical scale of pain [0-10]) with functional impairment and mild pain relief with unknown analgesics/anti-inflammatory drugs. On physical examination the patient reported pain during left humerus greater tubercle palpation and left shoulder active range of motion was limited by pain in flexion (150°), abduction (120°) and internal rotation (50°). Jobe, Neer, Hawkins and Yocum maneuvers were positive on the left side. He had already performed the following diagnostic procedures:

- Left shoulder ultrasound (2008.02.18) - "*acromion-clavicular joint arthrosis, (...), supraspinatus muscle calcic tendinitis sub-acromial conflict*";
- Left shoulder computed tomography (2008.02.29) - "*calcification of the rotator cuff*";
- Shoulders ultrasound (2008.09.12) - left shoulder: "*slight supraspinatus muscle tendinitis with calcification, sub-acromial conflict*"; right shoulder: "*microruptures of the supraspinatus muscle, choro-acromial conflict*"; and
- Shoulders radiographs (2008.10.02) - left shoulder: "*soft tissue calcification at the level of greater tubercle, acromion-clavicular arthrosis with conflict*"; right shoulder: "*soft tissue calcification at the level of greater tubercle, acromion-clavicular arthrosis*".

The following definitive clinical diagnoses were posted: bilateral calcifying tendinitis of the rotator cuff, sub-acromial conflict syndrome and bilateral osteoarthritis of the acromion-clavicular joint. It was defined the following therapeutic approach: oral and topical non-steroidal anti-inflammatory (ibuprofen, flurbiprofen) and analgesic (magnesium metamizole) drugs taken in a SOS regimen, proton pump inhibitor (omeprazole) and physical therapy to the left shoulder (16 sessions, twice a week) with kinesiological techniques (assisted active/active mobilization, maximum range of motion possible with no pain), manual massage with topical non-steroidal anti-inflammatory drugs and physical agents (ultrasound - 1,5W/cm,<sup>2</sup> 1MHz, continuous and dynamic, 8 minutes - and diclofenac iontophoresis - cathode, 12 minutes). Each session had the following order: manual massage with topical non-steroidal anti-inflammatory drugs, ultrasound, iontophoresis and shoulder mobilization.

The patient only started the physical therapy treatments two months later (2009.02.16) and he was reassessed in the Physical and Rehabilitation Medicine consultation (2009.04.08) referring clinical and functional improvement of the left shoulder and worsening of nociceptive pain complaints with functional impairment in the right shoulder. The physical examination revealed bilaterally pain on greater tubercle palpation and the following shoulders range of motion: 170° on active flexion and abduction, in both shoulders (rotations not registered). It was prescribed a new series of the same physical therapy treatments (20 sessions, twice a week), this time to both shoulders, with the introduction of isometric muscular strengthening and acetic acid (2%) iontophoresis instead diclofenac one.

The patient restarted the physical therapy treatments (2009.04.13) and was reassessed again in Physical and Rehabilitation Medicine consultation (2009.06.08). He had pain on greater tubercle palpation of both shoulders, but mainly on the right one. He also referred pain with right shoulder mobilization. The shoulders range of motion was the same of the previous physical examination. Two weeks later (2009.06.24) the patient presented similar physical examination except on the right shoulder range of motion – 140° on flexion and abduction, both active. This negative evolution was associated to maintenance of physical efforts during working hours. It was prescribed another series of physical therapy treatments (15 sessions, twice a week) changing the percentage of acetic acid used in the iontophoresis to 5%.

The patient was evaluated in Physical and Rehabilitation Medicine consultation (2009.09.03) where he noted bilateral shoulder pain (nociceptive, mechanic rhythm, mainly on the right side). The shoulders range of motion were: left shoulder – 170° on active flexion and abduction; right shoulder – 90° on active flexion, 60° on active abduction, “hand on the buttock” on active internal rotation and 10° on active external rotation. Hawkins and Yocum maneuvers were positive on the right side. The patient had shoulders radiographs (2009.07.08) showing a calcification of 13,7mm in the right supraspinatus tendon (Figure 1) and no radiologic evidence of calcifications on left shoulder; it was performed an ultrasound to the right shoulder that revealed “*significant calcification projected to the distal segment and fair-insertional tendon of the supraspinatus with about 1,4cm long axis in relation to the process of calcified tendinitis*”. A new series of physical therapy treatments (15 sessions, twice a week) was prescribed, introducing short-wave treatments to the right shoulder (continuous, transverse application, 20 minutes) with an analgesic objective.



**Figure 1** - Right shoulder radiograph at beginning of treatment with acetic acid (5%) iontophoresis.

Two months later (2009.11.04) the patient returned to the Physical and Rehabilitation Medicine consultation and he complained of static and dynamic right shoulder pain. He had the following right shoulder range of motion: 120° on active flexion and abduction (rotations not registered). It was requested to conduct further right shoulder radiographs and it was prescribed one more series of physical therapy treatments (15 sessions, twice a week). In the beginning of this year (2010.01.13) the patient came to the Physical and Rehabilitation Medicine consultation and he reported improvement on right shoulder pain. The physical examination showed no pain on shoulders palpation and the range of motion of right shoulder was as follows: 130° on active flexion, 140° on active abduction, 70° on active internal rotation and 40° on active external rotation. Right shoulder radiographs (2009.11.11) showed a decrease in the size and density of the calcification (Figure 2), so it was decided to repeat the radiographic evaluation.

The last time the patient was observed (2010.02.10), he had clinically improved by assigning a value of 2 on numerical scale of pain (0-10). Shoulders range of motion were: left shoulder – 170° on active flexion and abduction; 60° on active internal rotation and 55° on active external rotation; right shoulder – 140° on active flexion and abduction; 70° on active internal rotation and 45° on active external rotation. Note that during all this time the patient never interrupted his professional activity characterized by hard work. Right shoulder radiographs (2010.01.27) revealed the



**Figure 2** - Right shoulder radiograph during treatment with acetic acid iontophoresis.



**Figure 3** - Right shoulder radiograph after treatment with acetic acid iontophoresis.

absence of calcification suggestive images (Figure 3). It was then decided to discontinue physical therapy treatments and teach some exercises to perform at home. It was also suggested the maintenance of SOS anti-inflammatory and analgesic medication, and follow consultation in Physical and Rehabilitation Medicine.

## Discussion

Calcifying tendinitis is bilateral in 20 to 30 percent of shoulder cases and deposits are often seen in other locations if other radiographs are taken.<sup>1,3</sup> The calcification may vary in radiographic appearance (thin, outlining the tendon sheath, or hazy), density, definition, size (few millimetres to 1-5cm), number and location (usually 1-2cm from the insertion of the supraspinatus tendon on the greater tubercle).<sup>1,2</sup> Calcifying tendinitis may be related with several diseases (diabetes, thyroid disorders, and others) as shoulder use (repetitive motion performed in a professional context), affects mainly 30- to 60-year-old individuals and is most frequent in women.<sup>1,3</sup> It is possible that there is also a genetic and/or metabolic link.<sup>1</sup>

The clinical polymorphism of calcifying tendinitis of the shoulder is common but the diagnosis is usually easy considering that it is a nosological entity with its own characteristics which differentiates it from degenerative tendinitis or subacromial impingement.<sup>1,3,5</sup> Acute inflammatory crisis is characterized by severe pain, tenderness, and local oedematous inflammation sometimes leading to restricted active and passive motion.<sup>1</sup> Chronic symptoms are more or less severe pain and tenderness leading to various degrees of incapacitation, which induce the demand for radiographs – lateral and anteroposterior x-ray films are usually sufficient to see shoulder calcification, though special views in internal or external rotation may be necessary.<sup>1</sup>

The etiopathogeny of calcifying tendinitis remains unclear although several aetiopathological schemes have already been proposed.<sup>1,3</sup> Relative ischemia, degeneration of the tendons and metabolic disturbances have been suggested as possible causes for the fibrocartilaginous transformation of the tendon tissue that leads to calcium deposits.<sup>2</sup>

The course of the disease may be cyclic, with spontaneous resorption and reconstitution of the tendon.<sup>2</sup> In the acute phase, spontaneous resorption may occur within a period of two to three weeks, but in patients with chronic calcifying tendinitis, calcifications are still present in more than 90 percent after three years.<sup>2</sup> Spontaneous resorption may be typical for calcium deposits that appear translucent or cloudy and are not clearly circumscribed on radiographs.<sup>2</sup> As both symptoms and deposits often disappear spontaneously, both clinician and patient probably could abstain from interfering, however the duration of the spontaneous course of calcifying tendinitis differs individually and is reported to last from a few months to several years.<sup>1,4</sup> This patient had



a homogeneous and clearly circumscribed calcium deposit on right shoulder radiographs. In these cases, spontaneous resolution is thought to be uncommon, being that one more reason to invest in treatment.<sup>2</sup>

Iontophoresis was described initially by Le Duc in 1908 and the physiologic basis for this approach rests on the passage of topically applied, physiologically active ions through the epidermis – mainly hair follicle and sweat gland canals – through the polar effect of continuous direct current.<sup>3,6,7</sup> Acetic acid, which is an inorganic anion negative in polarity, is applied under the cathode (negative electrode) and will migrate toward the anode (positive electrode) while submitted to galvanic current.<sup>3,6,8</sup> Transdermal penetration of acetic acid was never been shown in humans because, as is the case with other agents administered by iontophoresis, there is no direct measurement of how deeply acetic acid penetrates into subcutaneous tissues in humans or the extent to which iontophoresis will enhance the penetration and binding of acetic acid to the calcifying lesion.<sup>3,8</sup> In addition, the penetration of an ionized product depends on a number of variables, including the concentration and diffusing capacity of the product used, subject age, vascularization, skin hydration and pH, skin condition, tissue depth and electric current; it is obvious that is very difficult to assess precisely the respective contribution of each one.<sup>3</sup>

The rationale behind using acetic acid iontophoresis in the treatment of calcifying tendinitis 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, as the following equation demonstrates:  $\text{CaCO}_3 + 2\text{H}(\text{C}_2\text{H}_3\text{O}_2)_2 = \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{H}_2\text{O} + \text{CO}_2$ .<sup>5,6,7</sup> Therefore, it is reasonable to expect a regression of the calcification.<sup>3,5-7</sup> Some results suggest that natural processes, rather than this specific treatment, are responsible for decreasing the size of calcifying lesions in the patients.<sup>8</sup> It seems not to be the case because this patient had a calcium deposit which characteristics were not favourable to a spontaneous resorption.

The clinical use of acetic acid iontophoresis in the treatment of patients with calcium deposits was first described in 1955 by Psaki and Carroll and again in

1977 by Kahn.<sup>3,6,9,10</sup> It has been investigated in the calcifying tendinitis of the shoulder and other calcifying conditions including traumatic myositis ossificans and systemic sclerosis-related calcinosis.<sup>3,5,6-8,9-</sup>

<sup>11</sup> There is a paucity of literature on the beneficial effects of acetic acid iontophoresis in treating clinical disorders such as calcifying tendinitis, but it remains a frequently used treatment for calcifying tendinitis of the shoulder because of its non-invasive character.<sup>3,8</sup> It is a cheaper option too, being the cost per treatment about US\$10.<sup>12</sup>

The only controlled and randomized clinical trial assessing the usefulness of acetic acid iontophoresis and ultrasound for the treatment of calcifying tendinitis of the shoulder has not shown significant clinical or radiologic effects (10 treatments 3x/week with 5% acetic acid).<sup>3</sup> Although it is true that the study failed to provide evidence of efficacy for this treatment, it is not true that it also proved the null hypothesis and there is a big difference between the two: absence of evidence does not mean that an intervention is ineffective.<sup>13</sup> There is some evidence that treatment with acetic acid iontophoresis and ultrasound is efficacious in calcifying tendinitis of the shoulder for both the modification of the calcification size as well as the solution of the pain picture (40 treatments 5x/week with 5% acetic acid).<sup>5</sup> This patient performed a total of 65 treatments, twice a week, with acetic acid iontophoresis, of which the last 45 were with 5% acetic acid. Unfortunately, it was impossible to perform more treatments per week, so it is possible that the therapeutic effect has been slower than in other studies.

Ultrasound therapy is widely used for the treatment of painful musculoskeletal disorders and in patients with symptomatic calcifying tendinitis of the shoulder it helps resolve calcifications and is associated with short term clinical improvement.<sup>2</sup> The way in which ultrasound stimulates the calcium deposits resorption has not been established, but it seems that the mechanical and thermal action of ultrasound helps the calcification break down and improves its resorption by increasing the local blood supply.<sup>2,5</sup> This last fact may decrease the effectiveness of the medication at the delivery site by spreading the medication away from the target area when applied immediately after

iontophoresis.<sup>12</sup> For this reason, in this case, ultrasound therapy was done before iontophoresis in the physical therapy treatments. The measurement of the outcome portion attributable solely to ultrasound or iontophoresis in this case is quite difficult due to the simultaneous use based on a plausible synergistic effect.

The association of ultrasound, exercises and acetic acid iontophoresis to 2% did not prove to be better than the association of ultrasound, exercises and short wave in the calcifying tendinitis of the shoulder in relation to the pain relief and decrease of calcification size.<sup>11</sup> The addition of short wave treatments in the last two series aimed to achieve a better pain control, so that any direct effect on shoulder's calcification was not considered.

## Conclusion

The use of therapeutic acid acetic iontophoresis with or without ultrasound is predominantly empirical, based on reported biophysical effects within tissue and on anecdotal experience in clinical practice, probably because it is relatively inexpensive and safe. Despite all doubts regarding the effectiveness of acetic acid iontophoresis on the treatment of calcifying tendinitis of the shoulder and any bias that this patient treatment may had, this case report appears to be another example of therapeutic success. However, the evidence of efficacy for this treatment should be provided by a double-blind randomized controlled trial with a large sampling of patients.

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