ORIGINAL ARTICLE

Effects of Ultrasound Therapy on Calcificated Tendinitis of the Shoulder

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Abstract. In general, surgery is recommended for calcificated tendinitis of the shoulder if the patients have symptoms after conservative treatments, including needle aspiration and physical therapy. Many researchers agree about the need for adequate physical therapy consisting of range of motion exercise, muscle strengthening exercises and electrophysical agents. Some researchers report that ultrasound (u/s) promotes angiogenesis and calcium uptake to fibroblasts, but there are few studies about u/s effects on calcificated tendinitis of the shoulder. The purpose of this study was to evaluate the u/s therapy effect on calcification, pain during active movement, and to identify factors related to improvement in a randomized controlled fashion. We used the stratified random allocation method to assign 40 consecutive patients to experimental and control groups, so each group consisted of 20 patients. The experimental group was treated by u/s therapy and therapeutic exercises, and the control group was treated with therapeutic exercises only. All patients in both groups came to our department 3 times per week and u/s therapy was performed 3 times per week until the end of the study. First, we classified the calcifications as type I (clearly circumscribed and with dense appearance on radiography), type II (dense or clearly circumscribed appearance) and type III (translucent or cloudy appearance without clear circumscription) according to the classification of Gartner and Heyer. Radiography was performed every one month, and the main outcome measure was the change from the base-line of the calcification on radiography at the end of the treatment. The three point scale of Gartner and Heyer was used, in which a score of 1 indicates no change or a worsening of the condition, a score of 2 a decrease of at least 50 percent in the area and density of the calcification, and a score of 3 a complete resolution of the calcification. We also examined the affected shoulders for presence or absence of pain in active movement at the start and at the end of the study. The calcifications improved significantly and fewer patients had pain during active movement in the experimental group. The results of this study suggest that u/s therapy helps to resolve calcifications of shorter disease duration. Calcifications of longer disease duration tended to persist in spite of u/s therapy, but we thought treatment of 27–38 times (95% CI), until score 2 was attained, was a desirable strategy.

Key words: ultrasound therapy, calcification, pain

Calcificated tendinitis of the shoulder is characterized by a reactive calcification that mainly affects the rotator-cuff tendons1). Plenk et al.2) found that 82 percent of calcifications located in the suprasupinatus tendon; Bosworth et al.3) found 90 percent in the suprasupinatus and infrasupinatus. Approximately 50 percent of patients with calcificated tendinitis have shoulder pain and restrictions in range of motion, thus limiting their activities of daily living4).
In general, surgery is recommended if the patients have symptoms after conservative treatments, including needle aspiration and physical therapy\(^1\). But Depalma and Kruper\(^5\) gained the impression that the period of convalescence was longer in patients treated surgically than in conservatively managed persons. McKendry \textit{et al.}\(^4\) showed that postoperative symptoms persist for much longer periods than anticipated.

It is generally accepted that adequate physical therapy consists of range of motion exercise, muscle strengthening exercises and electrophysical agents\(^6\)\(^7\). Ultrasound (u/s) therapy with an intensity ranging from 0.5 to 2.0 W/cm\(^2\) of body-surface area is widely used for the treatment of painful musculoskeletal disorders\(^8\). Some researchers reported that u/s promotes angiogenesis\(^9\) and calcium uptake to the fibroblast\(^10\), but there are few studies about u/s effects on calcified tendonitis of the shoulder.

We found previous reports about u/s therapy to calcified tendonitis of the shoulder\(^11\)\(^12\), but there are many differences between the equipment in use before and after the FDA regulations of 1996\(^13\). In recent research, Ebenbichler \textit{et al.}\(^14\) used u/s therapy on calcified tendonitis of the shoulder in a randomized double-blinded fashion. They concluded that u/s treatment helps resolve calcification and is associated with short-term clinical improvement.

The purpose of this study was to evaluate the u/s therapy effect on calcification, pain during active movement, and to identify factors related to the improvement in a pragmatic randomized controlled fashion.

\textbf{Materials and Methods}

\textit{Participants}

Between April 1997 and March 2001, 40 consecutive patients with radiographically verified calcified tendinitis were recruited for this study. Patients were excluded if they had gout, rheumatoid arthritis and calcifications which were stippled and overlay the bony insertion, because they are always accompanied by degenerative bony or articular changes\(^1\).

The purpose and methods of this study were explained to the patients in advance, and their consent to participate in this study was obtained.

\textit{Randomization}

We used the stratified random allocation method to assign the 40 patients to experimental and control group, so each group consisted of 20 patients.

\textit{Procedure}

1. u/s therapy

The u/s unit we employed was an Omnisound 3000C (Physio Technology INC., Topeka, KS, USA). The transducer surface area is 5 cm\(^2\) in diameter and the effective radiating area (ERA) is 4.3 cm\(^2\). Beam non-uniformity ratio is 3.2:1. The unit was calibrated via an u/s power meter prior to the study.

The u/s therapy was administered to the area over the calcification for 5 minutes per ERA at a frequency of 3 MHz and an intensity of 1.0 to 2.0 W/cm\(^2\) in continuous mode\(^15\). The coupling medium used in this study was SCAN (Parker Laboratories, NJ, USA). First, we applied sufficient gel to the treatment area without bubbles\(^16\). After that the transducer was moved slowly in circles over the treatment area and it was kept perpendicular to the skin surface during the treatment. Treatment of suprasupinatus and infrasupinatus was performed with the patient’s upper arm in an internally rotated position and subscapularis was performed in an externally rotated position. Treatment of long head of biceps was performed in a neutral position.

The u/s therapy was performed 3 times per week until the end of the study.

2. Therapeutic exercise

Therapeutic exercises consisted of stretching exercise, strengthening exercise to shoulder muscles, and joint mobilization. In an explanatory trial, the amount of therapeutic exercises is controlled, but in our pragmatic trial it was not.

All patients in both groups came to our department 3 times per week.

The experimental group was treated by u/s therapy and therapeutic exercises and the control group was treated with therapeutic exercises only.

\textit{Outcome measures}

First, we classified the calcifications as type I (clearly circumscribed and dense appearance on radiography), type II (dense or clearly circumscribed appearance), and type III (translucent or cloudy appearance without clear circumscription) according to the classification of Gartner and Heyer\(^17\).

Radiography was performed every one month and the main outcome measure was the change from the base-line in the calcifications on radiography at the end of the treatment assessed by 3 physical therapists in our department. The three point scale of Gartner and Heyer\(^17\) was used, in which a score of 1 indicates no change or a worsening of the condition, a score of 2 a decrease of at least 50 percent in the area and density of the calcification, and a score of 3 complete resolution of the calcification.

We also examined the affected shoulders for presence or absence of pain in active movement at the start and at the end of the study.
Statistical analysis

A chi-square test of association and independent t test were used to determine whether patients in the two groups were equally distributed at the baseline, across the scores (1 to 3) and pain during active movement.

A Mann-Whitney U-test was used to determine whether there was a significant disease duration difference from the first clinical presentation between score 2 and score 3 in the experimental group.

The 5% significance level was used for all hypothesis testing.

Results

There were no withdrawals, so a total of 40 patients were enrolled throughout this study.

Base-line evaluation

There were 15 type I calcifications, 4 type II and 5 type III in the experimental group. Two patients had type I calcifications in both the supraspinatus and infraspinatus, and another 2 patients had calcifications in the supraspinatus, subscapularis and long-head of biceps.

In the control group, there were 9 type I calcifications, 4 type II and 7 type III. Two patients had complicated diabetes mellitus in the experimental group. In the control group, all patients had one calcification in at least one muscle, and one patient had complicated diabetes mellitus.

All patients in both groups had pain during active movement.

There were no differences between the experimental and control groups as determined by chi-square test and independent t test (p>0.48).

Base-line characteristics are summarized in Table 1.

Radiological assessment (Table 2)

In the experimental group at the end of the treatment, 14 calcifications were completely resolved (score 3), and 7 calcifications had improved to score 2. There were no score 1. In score 3, there were 5 type I calcifications, 4 type II and 5 type III at the base-line evaluation. On the other hand, all calcifications were type I in score 2 at the base-line evaluation.

The u/s radiation was performed a mean 28 times for score 3, and a mean 39 times for score 2. Five patients continued u/s therapy after gaining score 2 to try for more improvement (15–67 times), but there was no effect on the calcifications.

In the control group at the end of the treatment, 4 calcifications were completely resolved (score 3), 3 calcifications improved to score 2, and 13 calcifications did not improve at all (score 1). In scores 3 and 2, all calcifications were type III at the base-line evaluation. In score 1, type I calcifications were 9, and type II were 4.

A significant difference across the scores in the two groups as determined by chi-square test (p<0.0001).

Disease duration from the first clinical presentation (Table 3)

Disease duration at the first clinical presentation was an important factor affecting score. The mean disease duration was 61.0 months in score 2, on the other hand, it was 22.3 months in score 3.

There was a statistical significant disease duration difference at the first clinical presentation between scores 2 and 3 (p<0.02).

<table>
<thead>
<tr>
<th>Table 1. Base-line characteristics of 2 groups</th>
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<tbody>
<tr>
<td>Characteristics</td>
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<td>Age (year)</td>
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<td>Sex (number)</td>
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<td></td>
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<tr>
<td>Location</td>
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<tr>
<td>Supraspinatus</td>
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<td>Infraspinatus</td>
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<td>Subscapularis</td>
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<td>Type of calcification</td>
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<tr>
<td>I</td>
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<tr>
<td>II</td>
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<td>III</td>
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<td>Treatment duration (month)</td>
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<th>Table 2. Radiological outcomes of both groups at the end of treatment</th>
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<tbody>
<tr>
<td>Group</td>
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<tr>
<td>Frequency %</td>
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<tr>
<td>Experimental</td>
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<tr>
<td>Control</td>
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*χ²=22.29, p<0.0001.

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<tr>
<th>Table 3. Disease duration related to score 2 and 3 in the experimental group</th>
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<tr>
<td>Score</td>
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<td>Score 2</td>
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<td>Score 3</td>
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*Significant at p<0.05.
presence of calcifications may trigger pain, and u/s therapy score 2 had pain at the end of the study. We thought the movement in both groups. All patients in both groups with diabetes of long duration treated with insulin for a long time was associated with a larger percentage of shoulder improvement. As the result of statistical test, disease duration in score 2 patients was longer than in score 3 patients in the experimental group. In patients with chronic calcificated tendinitis, calcifications are still present in more than 90 percent of patients after 3 years. We thought that patients presenting longer disease duration with type I were resistant to u/s therapy. While the disease durations of 2 patients with complicated diabetes mellitus in the experimental group were only 7 and 8 months, they did not improve better than score 2. Marvrikakis reported that diabetes of long duration treated with insulin for a long time was associated with a larger percentage of shoulder calcifications. It is unclear whether u/s therapy was effective or not because the sample size was small, but the results of the present study suggest that its effect was small in relation to calcifications with complicated diabetes mellitus.

No patients with score 3 experienced pain during active movement in both groups. All patients in both groups with score 2 had pain at the end of the study. We thought the presence of calcifications may trigger pain, and u/s therapy coupled with therapeutic exercise was effective on pain due to resorption of the calcifications.

The way in which u/s therapy resorbs calcification has not been established. It may act to increase circulation, to release a chemotactic factor, or to enhance phagocytosis to remove calcification. The results of this study suggest calcifications due to longer disease duration tend to persist in u/s therapy, but that u/s therapy should be continued for 27–38 times (95% CI) until patients gain score 2 outcomes.

### Acknowledgments

The authors would like to thank the orthopedists of our orthopedic department for their assistance with this study.

### References


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*χ²=10.1, p=0.0015.*
EFFECTS OF ULTRASOUND THERAPY ON CALCIFICATED TENDINITIS OF THE SHOULDER

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