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Extracorporeal Shockwave in Combination with Arthroscopic Surgery for Calcified Supraspinatus Tendinitis

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Abstract

Objective: Exploring the therapeutic effect of extracorporeal shockwave combined with Arthroscopic Surgery on calcified supraspinatus tendinitis.

Materials and Methods: Sixty patients with calcific supraspinatus tendinitis who received treatment in our hospital from June 2022 to June 2023 were randomly divided into two groups. All patients had disease lasting more than 6 months. The control group received extracorporeal shockwave therapy (ESWT), while the observation group, after undergoing arthroscopic debridement of calcific deposits in the joint, began receiving the same ESWT as the control group after 2 weeks. The differences in Visual Analog Scale (VAS) score, University of California at Los Angeles (UCLA) score, and Constant–Murley score between the two groups before and after treatment were recorded and compared.

Results: Before treatment, there was no significant difference in VAS score, UCLA score, and Constant–Murley Scale (CMS) score between the two groups of patients ($P > 0.05$); compared with before treatment, both groups of patients showed a significant decrease in VAS scores after 1 and 2 months of treatment ($P < 0.05$). After 1 and 2 months of treatment, the VAS scores of the observation group were significantly lower than the ones of the control group ($P < 0.05$). Compared with before treatment, the UCLA score and CMS score of both groups of patients significantly increased after 1 and 2 months of treatment ($P < 0.05$). After 1 and 2 months of treatment, the UCLA score and CMS score of the observation group were significantly higher than those of the control group ($P < 0.05$).

Conclusion: The combination of extracorporeal shockwave and arthroscopy has a significant therapeutic effect on calcified supraspinatus tendinitis, helping to improve shoulder joint function and effectively alleviate pain in patients.

Keywords: Extracorporeal shockwave, Arthroscopy, Calcifying supraspinatus tendinitis, Shoulder joint function, Pain

Introduction

Calcified supraspinatus tendonitis has an incidence ranging from 2.7% to 20%, with a higher prevalence in women, and in the right shoulder, it especially affects patients aged 30 to –50 years [1]. The clinical incidence varies in different tissues of the rotator cuff structure of the body. Calcification of supraspinatus tendon is the most common type of rotator cuff calcified tendonitis [2, 3]. In general, it is believed that the teres minor has the least incidence, followed by the subscapularis and infraspinatus.

In early stages, patients often complain of local pain even at rest and limited range of motion (ROM). As the disease progresses, the shoulder pain gets worse, with significant tender points in the lateral inferior acromion and severe limitation of shoulder motion until the complete loss of shoulder motion in some cases, thereby causing serious inconvenience to patients' normal work and life, as well as dramatical decline in their quality of life.

At present, there are many clinical therapies for the calcified supraspinatus tendonitis, such as physiotherapy, extracorporeal shock wave therapy (ESWT), corticosteroid injection, ultrasound-guided percutaneous needle aspiration and lavage, and arthroscopic and open surgery. Among them, the ESWT has the advantages of low treatment cost, fewer complications, and less tissue damage. It may significantly reduce the calcification area, improve the shoulder function, and alleviate the clinical symptoms [4]. The treatment results of surgery in combination with extracorporeal shock wave were investigated in patients with calcified supraspinatus tendonitis in the present study in order to provide more ideas for the diagnosis and treatment of patients in clinical practice.

Materials And Methods

Clinical data

A total of 60 patients with calcified tendinitis treated in our hospital from June 2022 to June 2023 were enrolled as study subjects and randomly divided into two groups: Control group (n = 30) and observation group (n =

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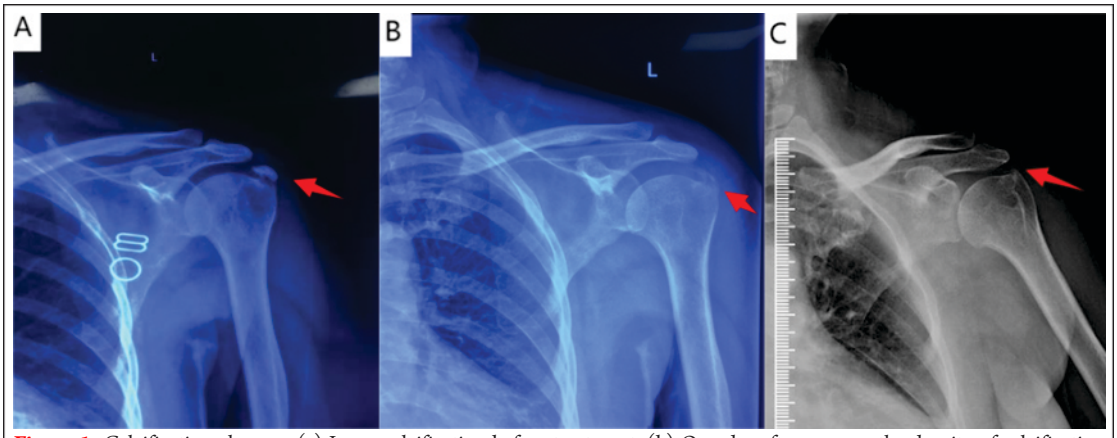

Figure 1: Calcification changes. (a) Large calcification before treatment. (b) One day after surgery, the density of calcification decreases. (c) Six weeks after surgery, after 4 sessions of shockwave therapy, the calcification shadow is almost gone.

30). Among them, those in the control group were aged 42-58 years with an average of 49.36-5.10 years, including 12 males and 18 females, as well as a body mass index (BMI) of 21-26 kg/m^2 and an average of 23.67-3.10 kg/m^2, while those in the observation group were aged 41-59 years with an average of 50.16-5.34 years, including 11 males and 19 females, as well as a body mass index (BMI) of 21-26 kg/m^2 and an average of 23.37- 3.05 kg/m^2. There was no significant difference in clinical data between the two groups (P > 0.05).

Inclusion criteria

(1) Patients who meet the diagnostic criteria of calcified supraspinatus tendinitis; (2) patients who have no significant abnormalities in liver and kidney function and coagulation function; (3) patients who have had an onset for more than 6 months, with shoulder pain accompanied by limitation of motion, and calcified lesions on B-ultrasound and X-ray; (4) patients who have no significant tear of the rotator cuff, as well as no infection or tumor in the shoulder; and (5) patients who have experienced the first onset of unilateral shoulder.

Exclusion criteria

(1) Patients who have suffered from shoulder pain caused by acromial impingement syndrome or avulsion fracture of the greater tuberosity of the humerus, etc.; (2) radiological images that demonstrate the process of spontaneous resorption of the calcification; (3) patients with shoulder fixation; (4) patients who have recently used non-steroidal analgesics or steroid injections; (5) patients who have experienced skin contusion of shoulder joint; (6) patients with severe osteoporosis, (7) had a cardiac pacemaker, or (8) patients with cardiovascular disease and other internal medicine diseases.

Study methods:

ESWT was applied in the control group using a focused electromagnetic shock wave therapy device (Dornier Aries AR2R, Germany). The patient was sitting and his/her shoulder joint on the affected side was fully exposed. The supraspinatus tendon was faced on the upper side of the shoulder. The patient's pain point was marked as an impact point according to the image positioning. The gel was applied on the handle of the treatment device. The tender point and the handle were kept for an included angle at 90°. The patient response was closely observed and treated within the tolerable range of pain. The energy range of the shock wave was within 0.11-0.20 mJ/mm^2 and the number of shocks was between 2000 and 3000. The treatment was performed once every week for 4 consecutive treatment courses. Position management should be carried out at the time of treatment in order to avoid affecting the treatment results due to changes in body position. Patients were given a cold compress for 15-20 minutes each time within 3 days after each therapy, once in the morning and once in the afternoon.

The observation group received a combined treatment of arthroscopic debridement of calcific deposits and extracorporeal shock wave therapy (ESWT), with the same methodology as in the other group.

For the surgical procedure, the patient was placed in a lateral position and the bony landmarks of the shoulder were marked after general anesthesia. The skin of the surgical area was routinely disinfected before draping the sheets over it. After arthrolysis of the shoulder, a 1.0 cm incision was made at the 1.5 cm inside the acromion and 2.0 cm below the external angle. Then, 25 mL of normal saline was injected through the joint cavity to expand the cavity using a lumbar puncture needle. The arthroscope was placed in, and the probe was inserted so as to observe the boundaries and morphology of calcifications. A small incision was made at 2.5 cm away from the distal external angle of the acromion for the removal of the calcifications and electrogoagulation was performed to stop the bleeding. Then, the surgical area was rinsed; the incision was sutured; and the affected limb was immobilized.

Shockwave therapy was started two weeks post-surgery, with shockwave energy ranging from 0.11 to 0.20 mJ/mm^2 and a frequency of 2000 to –3000 shocks. Treatments were administered once per week, four 4 times consecutively.

Table 1: Comparison of VAS scores among patients (scores, (scores, $\bar{x}\pm s$)

Groups	Before treatment	1 month after treatment	2 months after treatment	*F*	*P*-value
Observation group (n=30)	7.39±1.17	3.36±1.08[a]	2.26±0.86[a]	13.025	0.001
Control group (n=30)	7.42±1.23	4.27±1.12[a]	3.25±1.04[a]	11.683	0.001
t	0.097	3.203	4.018		
P	0.923	0.002	0.001		

Notes: [a]compared with before treatment,P<0.05. VAS: Visual Analog Scale

Table 2: Comparison of UCLA scores among patients (scores, $\bar{x} \pm s$)

Groups	Before treatment	1 month after treatment	2 months after treatment	*F*	*P*
Observation group (n=30)	16.37±2.94	27.39±3.04	31.08±3.54	16.319	0.001
Control group (n=30)	16.58±2.81	24.67±3.16	28.37±3.26	13.375	0.001
T	0.283	3.396	3.084		
P	0.778	0.001	0.003		

Notes: [a] compared with before treatment, $P<0.05$. UCLA: University of California at Los Angeles

Observation target

1. Patient''s pain assessment: Based on a Visual Analogue Scale (VAS), the patients marked their pain scales by themselves with a 0-–10 cm long scale upon their pain degree, with 10 points for severe pain and 0 points for no pain. The times of the assessment were divided into three categories: Before treatment, 1 month after treatment, and 2 months after treatment.

2. Shoulder function assessment: According to the Shoulder Rating System of the University of California at Los Angeles (UCLA), the scale has a total of 35 points, including the satisfaction of patients, the range of motion (ROM) of the active shoulder flexion, the pain sensation, the joint function, and the flexion strength test. According to the information above, the patients were divided into three different levels: < 29 points for poor, 29-33 points for good, and 34-35 points for excellent. The patients self-assessed their satisfaction, functional activities, and pain, while the evaluator was responsible for checking the patients' muscle strength and the ROM of shoulder flexion. The times assessment were divided into three categories: Before treatment, 1 month after treatment, and 2 months after treatment.

3. Constant-Murley scale (CMS): The scale has a total of 100 points, including 65 points for the doctor's objective assessment on the patients and 35 points for the patient's own subjective assessment. The objective assessment included the shoulder strength and the ROM of the shoulder joint, and the subjective assessment included the impact of the shoulder joint on daily life and the level of pain. The times assessment were divided into three categories: Before treatment, 1 month after treatment, and 2 months after treatment.

Statistical analysis

SPSS26.0 statistical software was used for analysis. The measurement data were expressed by (`c±s) and analyzed by t-test and repeated measures analysis of variance, while the enumeration data rate was expressed by (%) and analyzed by c^2 test. P < 0.05 was considered that the difference was statistically significant.

Results

Patients' VAS scores

Before treatment, there was no significant difference in VAS scores between the two groups (P > 0.05). Compared with before treatment, the VAS scores of the two groups were significantly decreased at 1 month and 2 months after treatment (P < 0.05). The VAS scores of the observation group were significantly lower than those of the control group at 1 month and 2 months after treatment (P < 0.05). See Table 1.

Patients' UCLA scores

Before treatment, there was no significant difference in UCLA scores between the two groups (P > 0.05). Compared with before treatment, the UCLA scores of the two groups were significantly increased at 1 month and 2 months after treatment (P < 0.05). The UCLA scores of the observation group were significantly higher than those of the control group at 1 month and 2 months after treatment (P < 0.05). See Table 2.

Patient's CMS scores

Before treatment, there was no significant difference in CMS scores between the two groups (P > 0.05). Compared with before treatment, the CMS scores of the two groups were significantly increased at 1 month and 2 months after treatment (P < 0.05). The CMS scores of the observation group were significantly higher than those of the control group at 1 month and 2 months after treatment (P < 0.05). See Table 3.

Discussion

Calcified supraspinatus tendonitis is characterized by hydroxyapatite deposition in the tendon, which in turn induces tendon dysfunction. Its manifestations consist of local pain in the shoulder and varying degrees of limitation of motion. The pain is especially severe at night. Studies have shown that calcifications formed in the body may be associated with gout, hypoxia, ischemia, abnormal purine metabolism, diabetes mellitus, and abnormal estrogen, etc. [5]. However, the specific mechanism of calcification formation has not yet been fully understood.

Compared with other tendon tissues, the supraspinatus tendon of the rotator cuff is more susceptible to calcification, which seriously affects the shoulder function, resulting in shoulder local pain and dysfunction, and impairing the patient's daily work and life [6,7]. A large number of clinical experiences show that the blood supply is suboptimal and the perfusion is insufficient in the area of the supraspinatus tendon 1.5-2 cm from the humeral tuberosity.

Table 3: Comparison of CMS scores among patients before and after treatment (scores, $\bar{x} \pm s$)

Groups	Before treatment	1 month after treatment	2 months after treatment	*F*	*P*-value
Observation group (n=30)	50.16±7.20	76.74±7.60	83.65±8.24	15.038	0.001
Control group (n=30)	51.35±7.13	70.39±7.52	78.15±8.07	11.735	0.001
T	0.643	3.253	2.612		
P	0.523	0.002	0.011		

Notes: [a] compared with before treatment, $P<0.05$. CMS: Constant–Murley scale

Relevant literature at home and abroad suggests that calcification deposition, degeneration, and deterioration often occur in this part of the supraspinatus tendon [8,9]. At the same time, more comprehensive factors such as friction, extrusion, and collision, which occur between the greater tuberosity of the humerus and the acromion in this area, may pressure on the supraspinatus tendon, resulting in retrogression and strain in the site that is lacking blood vessels, thus leading to the change in tendon properties and further inducing the formation of calcifications and the occurrence of calcified tendinitis.

There are also experts reporting that the disease is also associated with some endocrine diseases of the body [2]. Some patients have increased serum hormone levels compared to healthy people. In addition, the patients with diabetes mellitus have a higher rate of rotator cuff calcified tendinitis than healthy people in clinical practice. However, the mechanisms associated with diabetes mellitus and calcified tendinitis remain unknown.

Uhthoff et al. [10] believed that this result may be related to the structural changes induced by cells metaplasia. In summary, the above discussed factors put in evidence that the mechanism of the disease is extremely complex, not only due to physiological structural factors such as trauma and strain, but also due to factors such as changes in the internal microenvironment of cells and abnormal metabolism, which jointly lead to the occurrence of the disease. In a study by Hughes and Bolton Maggs et al. [11], calcified tendinitis is divided into four different stages. Firstly, in the pre-calcification stage, the symptoms are not obvious and there are no abnormal changes in the tissues. Secondly, in the calcification stage, in which the tendon undergoes repeated injuries, resulting in the accumulation of proteoglycans in tissues. At the same time, tissue hypoxia causes tendon cells differentiating into chondrocytes, resulting in the deposition of calcifications. At this stage, the symptoms of the majority of patients are still not obvious and only a small number of them have developed pain. Thirdly, in the resorption stage, in the tissues near the calcium deposition appears micro-vascularization. A large number of inflammatory cells infiltrate and induce an aggressive inflammatory response. At this stage, the patients present with significant pain. Fourthly, in the late calcification stage, type II collagen is secreted in large quantities to fill the gaps, and then matures into type I collagen within 12-16 months [11].

Patients with calcified supraspinatus tendinitis in the early stage receives conservative treatment, including oral administration of anti-inflammatory and analgesic drugs, and ultrasound therapy, etc., which will achieve significant therapeutic effects.

As one of the clinically effective methods for the treatment of calcified tendinitis, the mechanism of action of ESWT is related to the following factors. Firstly, this method produces a cavitation effect, which has a positive effect on the patient's local microcirculation, enhances the oxygen uptake function of the blood, and accelerates the repair of damaged and degenerated tissues [12-14]. Secondly, it produces a metabolic activation effect, which may accelerate the regeneration of tissue capillaries and the dissolution of calcifications in the body. Thirdly, it produces a mechanical effect, thereby making the high-density calcifications split and dissolve. Foreign scholars have applied ESWT to the clinical treatment of calcified tendinitis. The results showed that the therapy significantly alleviated pain and impove joint function of the patients. Compared to intra-articular injection regimen, although it has short-term efficacy, there is a difference in long-term between the two groups [15]. Bannuru et al. [16] have systematically reviewed the high-energy ESWT and showed that this approach improves joint function and alleviates pain in patients with chronic calcified shoulder tendonitis. Lee et al. [17] considered ESWT an effective alternative for patients whose clinical symptoms cannot be relieved by conservative treatments such as physical therapy, injections, or oral NSAIDs. Whereas, for the patients with a long course of disease and no obvious effect of conservative treatment for more than 6 months, most scholars recommend arthroscopic surgery in order to completely remove calcifications [18]. This procedure has the advantages of minimal invasion, less bleeding, and fast post-operative recovery. It not only effectively avoids deltoid muscle injury caused by open surgery, but also has positive significance for reducing the risk of post-operative re-adhesion. However, there are still inconsistencies regarding the indications for arthroscopic surgery [18-, 19]. Moreover, for the patients with large calcifications in tendons, tight adhesion to the joint capsule, severe tendon degeneration, or a long course of disease, if the calcifications are forcibly removed, it will damage the rotator cuff tendons and joint capsule. Therefore, arthroscopic surgery still has certain limitations and drawbacks.

This study shows that the UCLA scores and CMS scores of the patients in the observation group and the control group at 1 month and 2 months after treatment are higher than those before treatment. Moreover, the UCLA scores and CMS scores of the observation group are higher than those of the control group ($P<0.05$), indicating that extracorporeal shock wave alone and extracorporeal shock wave plus arthroscopy have a certain effect on the improvement of shoulder function in patients with calcified supraspinatus tendonitis. However, the effect of combination therapy is more prominent. In addition, the VAS scores of the patients in the observation group and the control group at 1 month and 2 months after treatment are lower than those before treatment. Moreover, the VAS scores of the observation group were lower than those of the control group ($P< 0.05$), indicating that the external shock wave plus arthroscopy has a more significant effect on the improvement of the patients' pain than that of ESWT alone.

Conclusion

In conclusion, combination treatment of extracorporeal shock wave therapy and arthroscopy has shown significant efficacy in patients with calcific tendinitis of the supraspinatus tendon with a disease duration of over 6 months, improving shoulder function and effectively relieving pain.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflicts of Interest: Nil. **Source of Support:** None.

References

1. Nakhaie Amroodi M, Abdolahi Kordkandi S, Moghtadaei M, Farahini H, Amiri S, Hajializade M. A study of characteristic features and diagnostic roles of X-ray and MRI in calcifying tendinitis of the shoulder. Med J Islam Repub Iran 2022,36:79.

2. Kim MS, Kim IW, Lee S, Shin SJ. Diagnosis and treatment of calcific tendinitis of the shoulder. Clin Shoulder Elb 2020;23:203-9.

3. Louwerens JK, Claessen FM, Sierevelt IN, Eygendaal D, van Noort A, van den Bekerom MP. Radiographic assessment of calcifying tendinitis of the rotator cuff: An inter-and intraobserver stud. Acta Orthop Belg 2021;86:525-531.

4. Bechay J, Lawrence C, Namdari S. Calcific tendinopathy of the rotator cuff: A review of operative versus nonoperative management. Phys Sportsmed 2020;48:241-6.

5. de Witte PB, van Adrichem RA, Selten JW, Nagels J, Reijnierse M, Nelissen RG. Radiological and clinical predictors of long-term outcome in rotator cuff calcific tendinitis. Eur Radiol 2016;26:3401-11.

6. González-Martín D, Garrido-Miguel M, de Cabo G, Lomo-Garrote JM, Leyes M, Hernández-Castillejo LE. Rotator cuff debridement compared with rotator cuff repair in arthroscopic treatment of calcifying tendinitis of the shoulder: A systematic review and meta-analysis. Rev Esp Cir Ortop Traumatol 2023,12:187.

7. Verstraelen F, Bemelmans Y, Lambers Heerspink O, van der Steen M, Jong B, Jansen E, et al. Comparing midterm clinical outcome of surgical versus ultrasound guided needle aspiration of the calcific deposits for therapy resistant calcifying tendinitis of the shoulder. A comparative cohort study. J Orthop Sci 2023,18:91.

8. Michal M, Agaimy A, Folpe AL, Zambo I, Kebrle R, Horch RE, et al. Tenosynovitis with psammomatous calcifications: A distinctive trauma-associated subtype of idiopathic calcifying tenosynovitis with a predilection for the distal extremities of middle-aged women-a report of 23 cases. Am J Surg Pathol 2019;43:261-7.

9. Darrieutort-Laffite C, Najm A, Garraud T, Adrait A, Couté Y, Louarn G, et al. P039 Rotator cuff calcific tendinopathy: Chondrocyte-like cells surrounding calcific deposits express tnap and enpp1, two key enzymes of the mineralization process. Ann Rheum Dis 2018;16:162-8.

10. Uhthoff HK, Loehr JW. Calcific tendinopathy of the rotator cuff: Pathogenesis, diagnosis, and management. J Am Acad Orthop Surg 1997;5:183-91.

11. Hughes PJ, Bolton Maggs B. Calcific tendinitis. Curr Orthop 2002;16:389-94.

12. Kamonseki DH, da Rocha GM, Mascarenhas V, de Melo Ocarino J, Silveira Pogetti L. Extracorporeal shock-wave therapy for the treatment of non-calcific rotator cuff tendinopathy: A systematic review and meta-analysis. Am J Phys Med Rehabil 2023;???:???.

13. Moole H, Jaeger A, Bechtold ML, Forcione D, Taneja D, Puli SR. Success of extracorporeal shock wave lithotripsy in chronic calcific pancreatitis management: A meta-analysis and systematic review. Pancreas 2016;45:651-8.

14. Ji H, Liu H, Han W, Xia Y, Liu F. Bibliometric analysis of extracorporeal shock wave therapy for tendinopathy. Medicine (Baltimore) 2023,102:e36416.

15. Frizzero A, Vittadini F, Barazzuol M, Gasparre G, Finotti P, Meneghini A, et al. Extracorporeal shockwaves therapy versus hyaluronic acid injection for the treatment of painful non-calcific rotator cuff tendinopathies: Preliminary result. J Sports Med Phys Fitness 2017;57:1162-8.

16. Bannuru RR, Flavin NE, Vaysbrot E, Harvey W, McAlindon T. High-energy extracorporeal shock-wave therapy for treating chronic calcific tendinitis of the shoulder: A systematic review. Ann Intern Med 2014;160:542-9.

17. Lee SY, Cheng B, Grimmer-Somers K. The midterm effectiveness of extracorporeal shockwave therapy in the management of chronic calcific shoulder tendinitis. J Shoulder Elbow Surg 2011;20:845-54.

18. Balke M, Bielefeld R, Schmidt C, Dedy N, Liem D. Calcifying tendinitis of the shoulder: Midterm results after arthroscopic treatment. Am J Sports Med 2012;40:657-61.

19. Pieber K, Grim-Stieger M, Kainberger F, Funovics M, Resch KL, Bochdansky T, et al. Long-term course of shoulders after ultrasound therapy for calcific tendinitis: Results of the 10-Year follow-up of a randomized controlled trial. Am J Phys Med Rehabil 2018;97:651-8.

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