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Case Study

The effects of therapeutic exercise using PNF on the size of calcium deposits, pain self-awareness, and shoulder joint function in a calcific tendinitis patient: a case study

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Abstract. [Purpose] The purpose of this case study was to identify the effects of independent and intensive therapeutic exercise using Proprioceptive neuromuscular facilitation on the size of calcium deposits, pain self-awareness, and shoulder joint function in a patient with calcific tendonitis. [Subject and Methods] The subject was a 42-year-old female patient with calcific tendonitis and acute pain who had difficulty with active movement and problems with general function. The independent and intensive Proprioceptive neuromuscular facilitation exercise was applied for 40 min twice a day five times a week for two weeks for a total of 20 times. An X-ray, the visual analog scale, a simple shoulder test, the Constant-Murley Scale, and passive range of motion was used to evaluate the patient's change. [Results] The size of the calcium deposit, the visual analog scale score, and the simple shoulder test score decreased. The Constant-Murley Scale score and the passive range of motion were increased. [Conclusion] The results of this study suggested that intensive and independent therapeutic short-term exercise without any other exercise reduced pain and produced positive effects in shoulder function in a patient with the calcific tendonitis, which could confirm the importance of therapeutic exercise in the treatment of calcific tendonitis.

Key words: Calcific tendinitis, PNF, Shoulder joint

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INTRODUCTION

Calcific tendonitis is a reactive calcification disease caused by hydroxyapatite deposition that usually manifests in an acute and chronic state related to the rotator cuff[1, 2)]. While calcific tendonitis commonly appears at the attachment point of the supraspinatus, it has also been observed at the infraspinatus, teres minor, and subscapularis[3)]. The incidence of this disease ranges from 2.7% to 22% and occurs most frequently in 30–50-year-old women[4)]. Although the symptoms of calcific tendonitis improve naturally as the calcium deposit naturally dissolves, calcific tendonitis causes inconveniences in daily life and lowers patients' quality of life because the dissolution of the calcium deposits takes a long time and causes severe pain. Various conservative treatments of calcific tendonitis have been aimed at promoting the natural healing process or pain relief[5)].

The traditional direction for treatment of calcific tendonitis applies a conservative treatment again in the case of failure of the initial conservative treatment or after surgery in special cases[4–7)], Recently, oral medications and noninvasive and conservative methods, such as anti-inflammatory drugs and therapeutic exercise[8)], a combination of ultrasound therapy and therapeutic exercise[9)], a combination of ultrasound therapy and mesotherapy[10)], and extracorporeal shock wave therapy[5)]

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have been reported as effective methods to reduce the size of calcium deposits, provide pain relief, and improve shoulder function.

Proprioceptive neuromuscular facilitation (PNF) has proved to be an effective therapeutic exercise for patients with central nervous system impairments and patients with musculoskeletal diseases[11–13]. While studies have not emphasized the independent application of therapeutic exercises such as PNF for the treatment of calcific tendonitis, these exercises have been performed in combination with other exercises partially and restrictedly[8, 9]. Thus, the purpose of this case study was to identify the effects of independent and intensive short-term PNF on the size of a patient's calcium deposit, her pain self-awareness, and her shoulder joint function.

SUBJECT AND METHODS

The subject was a 42-year-old female patient with calcific tendonitis who reported acute pain in her right shoulder. The subject worked as a manager selling clothes for about 20 years in a department store, which usually involved displaying clothes and intermittently moving heavy boxes of clothes. Her diagnosis of calcific tendonitis of the supraspinatus was first confirmed about three years ago when she visited the hospital and overcame her pain through physiotherapy, prescription painkillers, and steroid injections whenever the pain occurred. She mentioned that her neck and shoulder was be continually felt but that she had no difficulty in carrying out the activities of her daily life in the meantime. Her chief complaint was severe pain that was persisted through rest. The pain would last for about 48 hours, and the sensitivity of pain was the highest at the greater tuberosity of the right humerus. Internal rotation of the shoulder was only possible for her with her right hand placed over her abdominal area. She only felt stable when her right hand was supported by her left hand. She did not perform shoulder movements such as flexion, extension, abduction, and lateral rotation, complaining that the pain increased if she tried to move even lightly. She mentioned that she received no benefits from physiotherapy, painkillers, and steroid injection even though she received the prescriptions for each as with existing. She wanted to participate in the PNF exercise program in this study.

No signs of rotator cuff impairment other than the calcific tendonitis on the supraspinatus were found on an ultrasound examination by the orthopedic surgeons in the hospital in which this study was conducted. The patient was prescribed therapeutic exercise combined with orally administered non-steroidal and anti-inflammatory drugs (NSIDs) and steroid injection to the subacromial space, but only the exercise program was performed because the subject rejected the drug and injection therapy. The subject voluntarily provided written informed consent to participate in this study after being provided information about the experiment. This study was approved by the Institutional Review Board of Namseoul University (NSU-160331-1).

An X-ray imaging system (Distal X-ray TITAN 2000, GEMSS Inc., Korea) was used to evaluate the size of the calcific deposit in the patient. A visual analog scale (VAS) was used to evaluate the patient's pain self-awareness. A joint test consisting of the simple shoulder test (SST), the Constant-Murley Scale (CMS), and passive range of motion (PROM) was used to evaluate the joint function of shoulder. A goniometer (Sammons Preston, USA) was used to measure the patient's PROM.

The X-ray image was referred to the radiology department of the hospital at Y-si, K-do. An image of the anteroposterior view of the shoulder joint was taken, and the calcification area of the supraspinatus was observed. The size of the calcific deposit was measured as a long and a short axis which the largest one was seen. The VAS is a scale used to measure subjective pain with a very high test-retest reliability (ICC=0.97)[14]. The subject rated her pain within a range of "0," which represented no pain, to "10," which represented severe pain[15]. The SST is a simple questionnaire (ICC=0.97) used to evaluate shoulder joint function. A subject completes the questionnaire by checking either "0" for yes or "1" for no in response to 12 questions. A lower SST score represents better shoulder function than a higher SST score[16]. The CMS is a standard clinical measurement method (ICC=0.96) used to evaluate shoulder joint function. The evaluation items in the CMS consist of pain, range of movement (ROM), activities of daily life, and shoulder strength. A total 100 scores are classified into subject (35 scores) and object elements (65 scores). A higher total CMS score represents better shoulder function than a lower CMS score[17]. The patient's PROM was measured by the method proposed by Norkin and White[18] using a goniometer (Sammons Preston, USA) (ICC=0.94)[19]. The average value of the patient's PROM was recorded after measuring her PROM three times.

The PNF exercise, which used a scapular and upper extremity pattern, was applied for 40 min twice a day five times a week for two weeks for a total of 20 times. The exercise in this study was applied as a combination of rhythmic initiation (RI) and combination of isotonic (CI) using the scapular pattern and upper extremity pattern of the PNF[20]. Before the exercise, a warm-up exercise was performed in the supine position that consisted of manual cervical traction, a ROM exercise, and rhythmic mobilization, which were performed tenderly and repeatedly within a range that did not cause the subject deep pain while carefully grasping the subject's right scapula. To move side-lying position which pain area goes up, the subject placed her hands on the shoulder of experimenter, and she was able to reach the most comfortable position for her. At this time, the experimenter grasped the subject's right scapula with his hands and performed mobilization by inducing a protraction and retraction movement. This exercise was applied over the subject's pain range with the subject in the side-lying position for the scapular pattern of the exercise and in the supine position for the extremity pattern. The eyes of the subject and her cervical movement were shown with the direction of the pattern when the upper extremity pattern was applied. A cool-down exercise that was the same as the warm-up exercise was performed after the primary exercise. The warm-up and cool-down exercise

were performed for 10 min each and the main exercise was performed for 20 min, resulting in a total exercise time of 40 min. The exercise was applied twice a day five times a week for two weeks for a total of 20 times. In the first week, a RI technique was applied ten times for two sets. In the second week, a CI technique was applied ten times for three sets. The intensity of the exercise was set to 11–12 degrees on the basis of the rating of perceived exertion of the subject. A post-test was performed 24 hours after the end of exercise period.

RESULTS

The results of this study are shown in Table 1. The change of the size of calcific deposit, VAS score, SST score, CMS score, and PROM over two weeks is shown in Table 1. The size of the calcific deposit decreased from 32.3 mm to 4.2 mm. The subject's VAS score decreased from 8.2 to 0.8. The subject's CMS score increased from 18 to 74 points. The subject's PROM increased from 70.3°, 13.7°, 53.7°, 16.0°, and 0° to 179.7°, 80.7°, 180.0°, 89.7°, and 85.3° for flexion, extension, abduction, internal rotation, and lateral rotation, respectively.

DISCUSSION

The cause of calcific tendonitis is not known[8] but studies related to conservative, noninvasive, and non-surgical interventions used to treat calcific tendonitis have proved that the absorption of calcific tendonitis occurs naturally[5, 8–10]. Several conservative interventions for the decalcification of calcific tendonitis, pain relief, and the improvement of joint function of the area affected by calcific tendonitis have been noted, but physiotherapies to treatment these symptoms, such as manual therapy and therapeutic exercises, have only been performed in combination with other conservative interventions[8, 9], Finding cases that applied independent, aggressive, and intensive physiotherapy for the treatment of calcific tendonitis is difficult. Thus, this study intended to identify the effects of intensive and independent PNF exercise on calcific tendonitis.

Choi et al.[21] reported that treating calcific tendonitis is possible with conservative treatment methods; perfect decalcification is not necessary, but confirming the perfect absorption of calcareous materials though ongoing treatment regardless of treatment method is clinically important. Porcellini et al.[22] reported that there was an inverse relation between the size of the calcification remaining on a tendon and shoulder joint function and that there was a strong correlation between a decrease in calcification and successful clinical results.

The results of this study corresponded with those of previous studies[21, 22]. The size of the patient's calcification decreased by about 86% from 135.7 mm^2 to 19.2 mm^2, and the subject's VAS, SST, CMS, and PROM results improved in accordance with this decrease. Abate et al.[9] reported there was a greater effect on the VAS and CMS scores of patients with calcific tendonitis of the rotator cuff in a group in which intervention with exercise was applied after ultrasound-guided percutaneous treatment (UGPT) than in a group in which passive exercise was applied with UGPT was applied. These results corresponded with the present study. Additionally, the study reported that stretching and a glenohumeral joint and scapulothoracic joint exercise task were effective for the recovery of physiological movement of the shoulder and for improving kinematic and neuromuscular control ability[9]. The muscle strength and endurance exercise increased the stability of glenoid and humeral head and contributed to the recovery of disuse atrophy and impairment related to chronic pain of the shoulder joint, which emphasized the importance of exercise. The application of PNF exercise therapy for this study not only showed promotion of postural reflex, but also improved performance capability under gravitational effect, increased activity of the acting muscles through eccentric contraction, and eased movement of both articular muscles using a diagonal exercise pattern[23]. In addition, Oh et al.[13] stated that PNF improved muscular strength and endurance, ensuring maintenance of normal muscle tone and reduction of pain. Furthermore, Funk et al.[24] reported that the groups which practiced PNF stretches experienced significant improvements in their ROM compared to their counterparts in the control groups; the positive effects of which lasted more

Table 1. Changes in clinical outcomes after therapeutic exercise using PNF

Variables	Pre-test	Post-test
Size of calcium deposit (mm^2)	32.3 × 4.2	14.8 × 1.3
Visual analog scale	8.2	0.8
Simple shoulder test (score)	12	2
Constant-Murley Scale (score)	18	74
Flexion of PROM (°)	70.3	179.7
Extension of PROM (°)	13.7	80.7
Abduction of PROM (°)	53.7	180.0
Internal rotation of PROM (°)	16.0	89.7
External rotation of PROM (°)	0	85.3

PROM: passive range of motion

than 90 minutes post-stretch. In the PNF intervention in this study, applying a CI technique on the scapula and upper extremity contributed to the improvement of muscle strength and endurance of the shoulder and the maintenance of normal muscle tone. Because these techniques resulted in pain relief and improvement of muscle strength and endurance[13, 23], they should improve VAS and SST scores. Also, as a result of the two patterns used in the application of PNF within this study, scapular movement and stability were improved; even enhancing the ability of the upper torso to maintain a neutral posture, which in turn developed the PROM of the shoulder joint as well as functional movements such as SST and CMS. As such, an overall improvement in muscle strength and movement/activity in the muscles of the upper torso were observed[23]. The applied PNF pattern consists of gross movement on diagonal which occur centered on the sagittal, frontal, and transversal planes. The combined functional exercises lead towards stabilizing the torso and improved proprioception along with the muscle strength: as a result, it can be concluded that all the dependent variables for this study were affected positively.

Some limitations for this study are due to the one-dimensional aspect of analyzing the results from a single subject, the narrow focus on supraspinatus tendinitis, and finally the difficulty of regulating the eating and daily habits of the subject.

This study suggested a possible way to improve the pain and function of patients with calcific tendonitis of the supraspinatus: the application of independent and intensive PNF exercise over a relatively short period of two weeks without other treatments. The positive results of this study could reaffirm the importance of exercise on the treatment of calcific tendonitis. The results of this study may be considered meaningful because this study attempted a new trial application of independent, aggressive, and intensive physiotherapy using PNF for the treatment of the calcific tendonitis. In the further study, the effectiveness of aggressive physiotherapy and sustainability of the effects of the therapy should be verified using a larger sample size.

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REFERENCES

1) Kandemir U, Bharam S, Philippon MJ, et al.: Endoscopic treatment of calcific tendinitis of gluteus medius and minimus. Arthroscopy, 2003, 19: E4. [Medline] [CrossRef]
2) Gosens T, Hofstee DJ: Calcifying tendinitis of the shoulder: advances in imaging and management. Curr Rheumatol Rep, 2009, 11: 129–134. [Medline] [CrossRef]
3) Uhthoff HK: Calcifying tendinitis. Ann Chir Gynaecol, 1996, 85: 111–115. [Medline]
4) Uhthoff HK, Loehr JW: Calcific tendinopathy of the rotator cuff: pathogenesis, diagnosis, and management. J Am Acad Orthop Surg, 1997, 5: 183–191. [Medline] [CrossRef]
5) Lee YT, Park JY, Song SH, et al.: The effect of extracorporeal shock wave therapy for calcific tendinitis of the shoulder. Korean J Sports Med, 2015, 33: 1–5. [CrossRef]
6) Wainner RS, Hasz M: Management of acute calcific tendinitis of the shoulder. J Orthop Sports Phys Ther, 1998, 27: 231–237. [Medline] [CrossRef]
7) Franceschi F, Longo UG, Ruzzini L, et al.: Arthroscopic management of calcific tendinitis of the subscapularis tendon. Knee Surg Sports Traumatol Arthrosc, 2007, 15: 1482–1485. [Medline] [CrossRef]
8) Scibek JS, Carcia CR: Presentation and conservative management of acute calcific tendinopathy: a case study and literature review. J Sport Rehabil, 2012, 21: 334–342. [Medline] [CrossRef]
9) Abate M, Schiavone C, Salini V: Usefulness of rehabilitation in patients with rotator cuff calcific tendinopathy after ultrasound-guided percutaneous treatment. Med Princ Pract, 2015, 24: 23–29. [Medline] [CrossRef]
10) Cacchio A, De Blasis E, Desiati P, et al.: Effectiveness of treatment of calcific tendinitis of the shoulder by disodium EDTA. Arthritis Rheum, 2009, 61: 84–91. [Medline] [CrossRef]
11) Oh DG, Sung SC, Lee MG: Effects of elastic band exercise using PNF and CNS-stimulating exercise on functional fitness and EMG in hemiplegic stroke patients. The Korea Society of Sports Science, 2011, 20: 815–827.
12) Ribeiro T, Britto H, Oliveira D, et al.: Effects of treadmill training with partial body weight support and the proprioceptive neuromuscular facilitation method on hemiparetic gait: a randomized controlled study. Eur J Phys Rehabil Med, 2013, 49: 451–461. [Medline]
13) Oh DG, Sung SC, Lee MG: Effects of chiropractic and PNF exercise on pain self-awareness and autonomic nervous function in forward head posture patients. Korea J Phys Educ, 2015, 54: 539–549.
14) Bijur PE, Silver W, Gallagher EJ: Reliability of the visual analog scale for measurement of acute pain. Acad Emerg Med, 2001, 8: 1153–1157. [Medline] [CrossRef]
15) Vernon H, Mior S: The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther, 1991, 14: 409–415. [Medline]
16) Lippitt SB, Harryman DT, Matsen FA: A practical tool for evaluation of function: the simple shoulder test. The shoulder: a balance of mobility and stability. Rosemont: American Academy of Orthopaedic Surgery, 1993.
17) Constant CR, Murley AH: A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res, 1987, (214): 160–164. [Medline]
18) Norkin CC, White DJ: Measurement of joint motion: a guide to goniometry, 4th ed. Philadelphia: F. A. David Company, 2009.
19) Kolber MJ, Hanney WJ: The reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical

report. Int J Sports Phys Ther, 2012, 7: 306–313. [Medline]
20) Adler SS, Beckers D, Buck M, et al.: PNF in practice: an illustrated guide, 3rd ed. New York: Springer, Berlin, 2008.
21) Choi CH, Kim SK, Lee HH: Conservative and arthroscopic treatment of calcific tendinitis. J Korean Should Elb Soc, 2007, 10: 167–174. [CrossRef]
22) Porcellini G, Paladini P, Campi F, et al.: Arthroscopic treatment of calcifying tendinitis of the shoulder: clinical and ultrasonographic follow-up findings at two to five years. J Shoulder Elbow Surg, 2004, 13: 503–508. [Medline] [CrossRef]
23) Oh DG, Sung SC, Lee MG: Effects of combined treatment of chiropractic and PNF exercise on musculoskeletal function in forward head posture patients. Korean J Sport Sci, 2016, 27: 258–271.
24) Funk DC, Swank AM, Mikla BM, et al.: Impact of prior exercise on hamstring flexibility: a comparison of proprioceptive neuromuscular facilitation and static stretching. J Strength Cond Res, 2003, 17: 489–492. [Medline]