

TREATMENT OF PERITENDINITIS CALCAREA OF THE SHOULDER
BY TRANSCUTANEOUS NERVE STIMULATION

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ABSTRACT

** Daily Stimulation **
Low-frequency transcutaneous nerve stimulation (TNS) is known to produce pain relief as well as widespread and prolonged increases in micro-circulation in the skin and other organs. Such stimulation has further been shown to eliminate skin calcium deposits in systemic sclerosis. The present study tested the effects of TNS on clinical symptoms in peritendinitis calcarea of the shoulder and the possibility that this procedure could eliminate calcium deposits in this disease. Ten patients with 14 calcareous shoulders received TNS-treatment with a follow-up time of 3-10 months. Two of these were classified as acute, 9 as chronic, and 3 as asymptomatic. Great relief of pain and of restricted mobility was encountered in 10 of the 11 symptomatic shoulders one week or two after the onset of daily stimulation with subsequent progressive improvement of residual complaints during the following weeks. There was one relapse after 2 months' freedom of pain.

Calcium deposits persisted in the 3 asymptomatic shoulders, but was completely eliminated or greatly reduced in 7 of the 11 symptomatic ones. Comparison is made with reported untreated series. Even if most shoulders with calcified peritendinitis will spontaneously improve in time, TNS-treatment shortens the period of incapacitation and discomfort, secures freedom of pain, and allows earlier mobilization. It may thus represent an alternative method to other therapeutic procedures, such as roentgen irradiation and injection of anesthetics and hydrocortisone, in this disabling disorder.

Key Words: Nerve stimulation, Transcutaneous, Peritendinitis calcarea humeri, Treatment

INTRODUCTION

The pain-relieving effects of low-frequency transcutaneous nerve stimulation is well known (references in 1, 2, 3). It was previously reported that such stimulation also eliminated calcium deposits in the skin and subcutis of a patient suffering from systemic sclerosis with calcinosis (4). The mechanism behind this effect is most likely a widespread and prolonged increase in skin microcirculation induced by the stimulation. This observation prompted the present study attempting to eliminate clinical symptoms and calcium deposits in patients with peritendinitis calcarea of the shoulder.

Peritendinitis calcarea is the most commonly used term (introduced by Sandström in 1929, ref. in 5) for the pathologic entity manifested by calcium deposits in the soft tissue surrounding joints and tendons, and which is commonly recognized as a potential source of pain. Such deposits are most frequently found in the shoulder, where calcification is localized to the four short rotator muscles, usually in supraspinatus close to its insertion on the tuberculum majus, less frequently in infraspinatus, and more seldom in teres and subscapularis (5, 6, 7). The calcium salts are mainly located at the border between the tendon and muscle (8). The tendons, in particular those of the supraspinatus, are chronically exposed to microtrauma due to pressure against the acromion during abduction of the arm. Degenerative changes with necrosis is seen in which calcium is deposited (5). By breaking into the subacromial bursa, the deposits are absorbed (7). As calcium accumulates in the diseased tendon, its sheath will be under tension, and the patient will experience more or less pain, coincident with restricted mobility. When acute pain is experienced, it is in many cases due to discharge of the calcareous material into the subacromial or subdeltoid bursa. The acute pain then usually rapidly subsides. Deposits greater than 1.5 cm have in the literature been classified as large; sooner or later these will give rise to symptoms (6).

Clinically the condition appears in an acute form (pain for one week or less before treatment), subacute form (pain one to four weeks), chronic form (pain longer than four weeks), and an asymptomatic form (9). This time relationship corresponds to that of other investigators and is followed in the present study in comparison of results. In chronic cases there may be periods of exacerbation. Pain is localized to the lateral shoulder region down to the insertion of the deltoid muscle and causes restricted motility with fixation of the arm in the adducted position. There is distinct tenderness corresponding to the tuberculum majus. In the severe acute form there is local edematous swelling in the same region.

It is essential in the evaluation of any form of treatment of this condition to realize that some patients may temporarily improve or go into remission without therapy, also with associated regression of calcium deposits. The incidence of such spontaneous remissions depends on the proportion of acute and chronic cases in the series, as this self-curative process is far more common in the acute form than in the chronic one. This problem will be dealt with in the Discussion.

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PATIENTS AND METHODS

Patients -- Nine females and 1 male aged 37-67 years (mean 52.3 years), suffering from shoulder pain, were referred from general practitioners to the Outpatient Department of Roentgenology for examination and eventual roentgen treatment. When calcium deposits were demonstrated, the patients were informed that they could choose between roentgen therapy or a new method, TNS, which was under trial. With the consent of the referring physician, TNS was then initiated. Both shoulders were examined, and in 4 patients calcium deposits were bilateral, making a total of 14 shoulders under study. Some patient data are given in Table 1.

As a rule no analgesic or anti-inflammatory drugs were given during the period of TNS-treatment. In most patients other form of therapy had previously been attempted: roentgen irradiation (5 patients), injection of local anesthetics and hydrocortisone (5 patients), and physiotherapy (2 patients) with no or only temporary effect.

Stimulation was carried out as previously described (4, 10). In short, a pocket stimulator (type EM-set 4736), delivered constant square wave pulses of low frequencies (2 Hz) to a negative electrode placed on the web between the 1. and 2. metacarpal bones, the positive electrode being situated at the ulnar border of the same hand. Each stimulus consisted of burst of five pulses, each of 0.2 msec duration, with an internal frequency of 100 Hz. The intensity was increased until local contraction of the adjacent muscles was obtained without producing pain, usually at 15-30 mA (at an output impedance of about 800 ohms). TNS-treatment was given daily in two or three sessions, each of 30 (occasionally 45) min duration. In the unilateral cases the affected extremity was stimulated; in the 4 patients with bilateral calcification the right and left hand was stimulated alternately every week.

Roentgenographic examination was carried out immediately before the start of the treatment, the second after 3 weeks with subsequent controls at 1 to 2 months' interval. Deposits may easily be obscured by the humeral head and thus be missed. For that reason fluoroscopy with the arm rotated throughout its full range of motion was performed preliminary to roentgenograms. Pictures with reduced exposure to visualize the structure of soft parts facilitated the search for small and faint deposits.

RESULTS

Clinical features -- The 14 shoulders with calcareous deposits were assigned to the various clinical categories (9) as follows:

1. Acute form -- 2 shoulders (Patients 1-2)
2. Chronic form -- 9 shoulders (Patients 3-10)
3. Asymptomatic form -- 3 shoulders (Patients 1, 2 and 4)

Essential clinical data and roentgenologic findings are presented in Table 1 and Figs 1 and 2. In the chronic form the ave-

Pas. No.	Age Sex	Classification Location	Duration of clinical symptoms		Calcium deposits		Fig.	
			Before TNS	After onset of TNS*	Before TNS Size(mm) Fig.	After onset of TNS Reduction Fig.		
1	43F	Acute Right	3 days	6 days (2 weeks)*	23x16	1A	Small fragments at 7. week	1B
		Latent Left	Asymptomatic	No		15x4	1C	Unaltered after 4 months
2	59F	Latent Right	Asymptomatic	No	13x7	1E	Unaltered after 4½ months	1F
		Acute Left	3 days	7 days (2 weeks)	20x10	1G	Complete absorption after 3 months	1H
3	48F	Chronic Right	6 years	7 days (8 weeks)	30x15	2A	Reduced to 2/3 after 2½ weeks then gradual elimination	2B
		Chronic Left	6 years	7 days (8 weeks)	20x10	2C	Complete absorption after 3½ months	2D
4	37F	Chronic Right	9 years	14 days (7 weeks)	35x11	2E	Residual traces after 4 months	2F
		Latent Left	Asymptomatic	No	11x3	2G	Unaltered after 4 months	2H
5	55F	Chronic Right	12 years	7 days (3 weeks)	10x6	2I	Small fragments after 6 weeks	2J
		Chronic Right	3 years	14 days (7 weeks)	30x12	2K	> 50% reduction after 4 months	2L
7	52F	Chronic Right	2 years	7 days (8 weeks)	20x5	2M	Unaltered after 6 months	2N
8	67F	Chronic Left	15 years	6 days (7 weeks)	8x7	2O	Unaltered after 3 months	2P
9	51F	Chronic Right	5 years	6 days (> 7 weeks)	8x7	2Q	Unaltered after 5 months	2R
10	63F	Chronic Right	5 years	> 8 weeks	20x6	2S	Unaltered after 2 months	2T

TABLE 1. Results of TNS-treatment in 14 shoulders affected with calcified peritendinitis.

* Time within parentheses indicates duration of some minor residual pain.

rage duration of complaints before TNS-treatment was 7 years (varying from 1 to 5 years with varying intensity), in most cases with progressively increasing symptoms during the last months or weeks prior to the initiation of TNS-treatment. In 4 patients with chronic pain there were acute exacerbations 4-6 weeks before TNS. The patients were observed for a period of 3-10 months (average 5.4 months) following the onset of TNS.

In response to TNS-treatment there was a rapid or more gradual alleviation of pain with restoration of freedom of motion to passive and active movements in 10 of the 11 diseased shoulders. Pain relief was reported after a few days of stimulation with progressive improvement during the first weeks. In the chronic cases minor residual pain with some limitation of motion

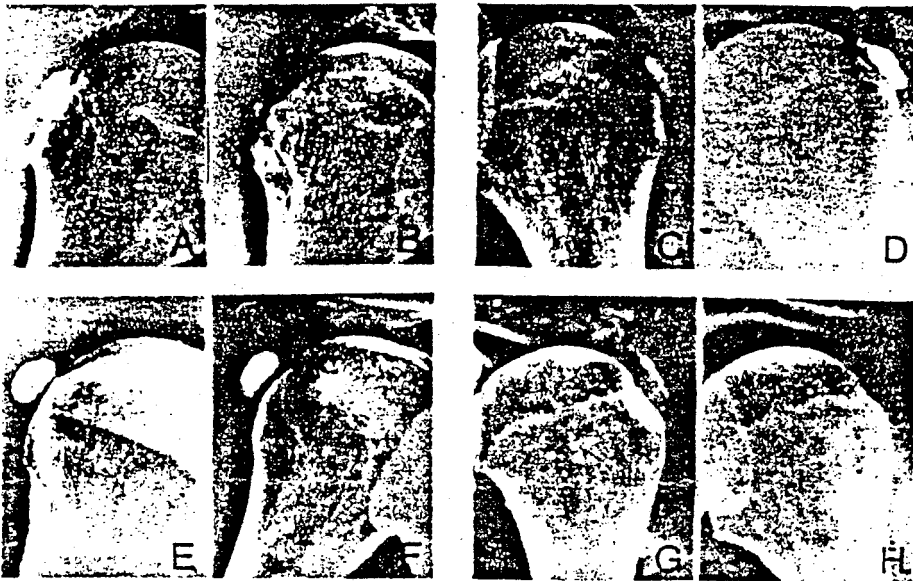


FIG. 1. Acute peritendinitis calcarea -- Elimination of calcium deposits during TNS-treatment in acute attacks in Patient 1 (A-B) and Patient 2 (G-H). No regression of calcium in 2 asymptomatic shoulders: Patient 1 (C-D) and Patient 2 (E-F). See Table 1 for clinical data.

persisted for 1-2 months. In 9 of these 10 patients with initially favorable response no relapse occurred during the observation time, whereas in one patient (No. 9) pain relief lasted temporarily for 2 months only. This patient had experienced chronic shoulder discomfort for several years and responded poorly also to earlier as well as to subsequent roentgen therapy. The only non-responder (No. 10) similarly later received roentgen therapy with only moderate relief.

Calcium deposits -- The roentgenographic shadows were usually located adjacent to the greater tubercle corresponding to the insertion of the supraspinatus muscle. In a few cases the shadows had a cloudy, mottled appearance with ill-defined borders. This was true in patients with an acute history of illness (Fig. 1A and 1G), whereas the chronic and asymptomatic cases usually displayed shadows of higher density and with sharper boundaries (Fig. 1C and E, Fig. 2). In 3 patients with chronic complaints steadily growing calcium deposits had been observed for periods of from 1 to 10 years before the initiation of TNS-treatment.

At the first roentgenologic examination following 3 weeks' TNS-treatment the calcium deposits were found to be reduced in 4 of the 14 shoulders. Thus, a patient may have relief of clinical symptoms without disappearance of calcareous collections, although these usually are diminished in size and density. An effort has been made to determine the ultimate fate of the calcium deposits (follow-up roentgen examination at 1-2 months interval). Absence of calcium at the final examination does not imply that the process of calcium removal requires this long period of stimulation.

Within these periods of observation, the calcareous deposits were unaltered in the 3 asymptomatic shoulders (Fig. 1 C-D, E-F, 2 G-H). In the 11 painful shoulders calcium was eliminated or greatly reduced in 7: the 2 with acute symptoms (Fig. 1 A-B, G-H) and in 5 of the 9 shoulders causing chronic complaints (Fig. 2 A-B, C-D, E-F, I-J, K-L), whereas they were essentially unaltered in size and density in the remaining 4 chronic shoulders (Fig. 2 M-N, O-P, Q-R, S-T). Shadows with a cloudy and more mottled appearance with greater radiolucency were in particular prone to be absorbed, whereas those with a dense and sharply outlined appearance were more resistant to TNS-therapy.

Patient No. 4 also presented a 7x7 mm calcareous deposit in the tissue around the left elbow with clinical symptoms for 3 years. This calcareous collection and associated clinical symptoms disappeared pari passu with those of the right shoulder during TNS-treatment.

FIG. 2. Chronic peritendinitis calcarea -- Elimination of calcium deposits in 5 out of 9 painful shoulders: Patient 3 (A-B) and (C-D), Patient 4 (E-F), Patient 5 (I-J), and Patient 6 (K-L). No effect on calcium deposit in 4 out of the same 9 shoulders: Patient 7 (M-N), Patient 8 (O-P), Patient 9 (Q-R), and Patient 10 (S-T). No regression of calcium in one asymptomatic shoulder: Patient 4 (G-H). See Table 1 for clinical data.

COMMENTS

The main question which we were endeavouring to answer in the present study was whether low-frequency TNS could be credited with shortening the period of disability and with calcium absorption in peritendinitis calcarea of the shoulder.

Clinical effects -- Clear clinical improvement, reduction of pain and restoration of motion was encountered in 10 of the 11 diseased shoulders immediately subsequent to the onset of TNS-treatment. Following the initial favorable response within the first or second week, there was - with one exception - a continued gradual recovery over the next few weeks, with no relapses during the observation time of from 3 to 10 months. The one non-responder and the one with relapse after 2 months, both chronic cases, also responded poorly to prior and subsequent therapy.

Although the present series is too small to allow any conclusion as to the merit of this alternative mode of treatment relative to other methods, such as roentgen therapy and local injection of anesthetic and hydrocortisone, it appears permissible to state that the improvements are within the same range as those reported for roentgen treatment: Thus, Milone & Copeland (11), who in 1961 compiled data from the literature, found that in the patients classified as having acute symptoms favorable clinical results by roentgen therapy varied from 87 to 100 %. In patients classified as chronic early improvement (within the first two weeks) were encountered in 33 % (12, 13) to 63 % (11), with late results varying from 67 % (12) to 81 % (9). These results are similarly equal to those of the needling and aspiration procedure and injection of anesthetic and hydrocortisone (11). In the present study early improvement occurred in 8 out of 9 of the shoulders with chronic symptoms.

Several authors dealing with the effects of roentgen treatment of calcareous peritendinitis have emphasized the importance of spontaneous regression of symptoms as well as of calcium deposits. Thus, according to Jones (14) and Plenk (15) regression of symptoms and absorption of calcareous deposits will result if sufficient time is given. In a study of 38 patients, Plenk obtained equally satisfactory clinical end-results after 6 weeks in a roentgenologically treated group and a group without treatment. Similar observations have been reported by Goldie et al. (16), who observed subjective improvement in 74 % of 70 patients with peritendinitis.

However, even if most shoulders with peritendinitis have a self-curative tendency and show similar end-results with and without specific therapy, use of methods that give rapid relief and shorten the period of morbidity are desirable to reduce the length of immobilization, disability and discomfort. With early alleviation of pain, early mobilization of the shoulder is made possible. In this respect roentgen irradiation, injection of anesthetics and hydrocortisone have proven as valuable tools. Klein & Klemes (17) observed in patients treated by physiotherapy a long period of disability, about 50 days, as compared to 10 days with roentgen therapy. To this therapeutic armamentarium TNS with its pain-relieving effects should be added.

Calcium deposits -- Studies concerning the fate of the calcium collections necessitate follow-up roentgenograms, as clinical symptoms entirely disappear long before the calcium is completely resorbed (11). The figures presented in the literature for untreated series vary considerably, obviously due to variation in the relative number of acute and chronic cases included in the investigation. There is general agreement that in the acute cases the calcium deposits display a more rapid and complete regression than in the longstanding, chronic cases (11, 18, 19, 20). In the present study no effect was seen on the calcium deposits in asymptomatic cases. Similarly, roentgen therapy has failed to produce absorption of the deposits in such patients (21).

In a series of about 6,000 unselected persons subjected to routine physical and fluoroscopic examination, Bosworth (6) observed calcium deposits in 202 shoulders. Calcium was entirely absorbed without treatment in 6 shoulders only (3 %) over a 3-year period. Bosworth's series was composed of employees of a large insurance company and likely contained a considerable number of chronic as well as asymptomatic shoulders. Klein & Klemes (17) observed gradual spontaneous disappearance of calcification without therapy in 12 % of their cases. Guido (22) reported that 2 out of 11 patients (18 %) in his series had complete remissions without treatment. However, considerably higher incidences of spontaneous calcareous absorption were encountered in the series studied by Plenk (elimination or reduction in 7 out of 12 untreated shoulders = 58 %), Arner et al. (16) (81 out of 102 = 80 %), and Jones (12) (6 out of 6 = 100 %). In the latter three studies, the majority of patients experienced acute attacks or acute exacerbations in 58, 57 and 100 % respectively.

This tendency to spontaneous remission in the acute cases makes it difficult to assess the effect of any form of therapy in this disorder. The present pilot series with the majority of painful shoulders in the chronic group (9 out of 11 cases) is more comparable with the former three series than with the latter three. Thus, calcium elimination in 5 out of these 9 shoulders (56 %) would perhaps indicate an effect on calcium absorption by low-frequency TNS-therapy. The elimination of calcium deposits in shoulders that had resisted other forms of therapy for years would strengthen this possibility. However, a definite answer to this question will require a larger series of patients.

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REFERENCES

1. Omura, Y., Simple custom-made disposable surface electrode system for non-invasive "electro-acupuncture" or TNS and its clinical applications including treatment of cephalic hypertension syndromes as well as temporo-mandibular joint problems, tinnitus, shoulder and lower back pain, etc. Acupuncture & Electro-Ther. Res. Int. J., 6, 109-134, 1981.
2. Kaada, B., Neurophysiological mechanisms of pain suppression and cutaneous vasodilation induced by transcutaneous nerve stimulation (TNS) and acupuncture - A review, pp. 64-94 in "Legevitenskap og livsvisdom", Festschrift to Tollak B. Sirnes on his 60th anniversary, October 17. 1982, University Press, Bergen, Norway, 1982. (Reprints available from the author).
3. Andersson, S.A., Holmgren, E. & Ross, A., Analgesic effects of peripheral conditioning stimulation - II. Importance of certain stimulation parameters. Acupuncture & Electro-Ther. Res. Int. J., 2, 237-246, 1977.
4. Kaada, B., Systemic sclerosis: Successful treatment of ulcerations, pain, Raynaud's phenomenon, calcinosis, and dysphagia by transcutaneous nerve stimulation. Acupuncture & Electro-Ther. Res. Int. J., Vol. 9, No. 1, 31-44, 1984
5. Sandström, C., Peritendinitis calcarea. A common disease of middle life: Its diagnosis, pathology and treatment. Am. J. Roentgenol., 40, 1-21, 1938.
6. Bosworth, B.M., Calcium deposits in the shoulder and subacromial bursitis. J. Am. Med. Ass., 116, 2477-2482, 1941.
7. Gschwend, N., Scherer, M. & Löhr, J., Tendinitis calcarea of shoulder joint. Orthopäde, 10, 196-205, 1981.
8. Pedersen, H.E. & Key, J.A., Pathology of calcareous tendinitis and subdeltoid bursitis. Am. Med. Arch Surg., 62, 50-63, 1951.
9. Kratzmann, E.A. & Frankel, R.S., Roentgen therapy of peritendinitis calcarea of the shoulder. Radiology, 59, 826-830, 1952.
10. Kaada, B., Vasodilation induced by transcutaneous nerve stimulation in peripheral ischemia (Raynaud's phenomenon and diabetic polyneuropathy), Eur. Heart J., 3, 303-314, 1983.
11. Milone, F.P. & Copeland, M.M., Calcific tendinitis of the shoulder joint. Am. J. Roentgenol., 85, 901-913, 1961.
12. Shoss, M. & Otto, T.G., Roentgen therapy of subdeltoid tendinitis and bursitis. Missouri Med., 52, 855-863, 1955.
13. Young, B.R., Roentgen treatment of bursitis of the shoulder. Am. J. Roentgenol. & Rad. Ther., 56, 626-630, 1946.

14. Jones, G.B., Painful shoulder. Calcification of the supraspinatus tendon. J. Bone & Joint Surg., 31B, 433-435, 1949.
15. Plenk, H.P., Calcifying tendinitis of the shoulder. Radiology, 59, 384-389, 1952.
16. Goldie, I., Rosengren, B., Moberg, E. & Hedelin, E., Evaluation of radiation treatment of painful conditions of the locomotor system. Acta Radiologica (Ther.), 9, 311-322, 1970.
17. Klein, J. & Klemes, I.S., Treatment of peritendinitis calcarea in shoulder joint. Radiology, 37, 325-330, 1941.
18. McCurrach, A.C., Norton, G.I. & Bouchard, J., Subacromial bursitis. A classification and an evaluation of the results of roentgen therapy. Can. Med. Ass. J., 61, 39-44, 1949.
19. Harmon, P.H., Methods and results in the treatment of 2,580 painful shoulders. With special reference to calcific tendinitis and the frozen shoulder. Am. J. Surg., 95, 527-544, 1958.
20. Arner, O., Lindvall, N. & Rieger, A., Calcified tendinitis (tendinitis calcarea) of the shoulder joint. Acta Chir. Scand., 114, 319-331, 1958.
21. Lorimer, A.A., Roentgen therapy in acute para-arthritis. Am. J. Roentgenol., 38, 178-195, 1937.
22. Guido, F.R., Acute calcified subacromial or subdeltoid bursitis. Calif. & West. Med., 60, 69-72, 1944.