SCENAR THERAPY IN THE TREATMENT OF MUSCULOSKELETAL PATHOLOGIES

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Physical therapy is constantly evolving along with the progress of technology and clinical experience, considering the large incidence of pathologies of the musculoskeletal system and the relative inadequacy of the therapies available in various cases. The wide range of pharmacological and physical therapeutic options available underlines the difficulty of finding an ideal therapy in the treatment of inflammation and pain. On the other hand, in general and in sports medicine in particular, there is a need to find not only an effective therapy but also a therapy that solves the problem in the shortest possible time. Therefore, the proposal of a new equipment for the treatment of pain can only be viewed with interest even when the scientific assumptions may not be entirely clear.

The history of electrotherapy is extensive and includes instruments with the most diverse names and characteristics, from direct currents to alternating ones to pulsed ones with rectangular, sinusoidal, triangular monophasic or biphasic waveforms, with frequencies ranging from 3 to thousands of Hz, with duration of the single impulse from microseconds to tenths of a second (Low and Reed, 2000; Gatto et al, 2000). All are based on the same scientific assumptions. The electrical impulse stimulates the excitable tissues that is nerves and muscles with direct and indirect effects. Nerves are not all the same. The motor and sensory axons of touch and proprioception are large in diameter, rapidly conducting and myelinated. The most numerous typical peripheral nerves are however small in diameter, slowly conducting and without myelin sheath. Predominantly they are nociceptive C fibers, the remainder are autonomic fibers. Depending on their diameter and position, they can be differently sensitive to external electrical stimuli.

In the area of application there is generally a cutaneous vasodilation due to axon reflex and release of histamine-like substances. Effects on non-excitable tissues with increased cell metabolism, reduction of capillary permeability, effects on plasma proteins with negative

electrical charges have also been hypothesized but the supporting scientific evidence is not clear (Low and Reed, 2000). The physiological effects of electrical impulses induced on nerve fibers are related to the type of fibers stimulated. The electrical stimulation of the A-beta fibers coming from the tactile receptors causes by reflex way, through the connections at the spinal level in the lamina 2 substantia gelatinosa of Rolando with the neurons of the A-delta and C fibers, reduction of the transmission of the pain signal defined presynaptic inhibition or segmental (Dickenson, 2002). Furthermore, in the lamina 2 substantia gelatinosa there are interneurons that produce enkephalins which inhibit the neurons of the C fibers contained in this area. The A-delta fibers are connected with these interneurons and therefore the stimulation of the A-delta fibers with electrical impulses can cause a reduction in signal transmission along the fibers of the pain system C. The high frequency TENS in case of joint inflammation activates the opioid receptors with reduction of the release in the spinal level of glutamate and aspartate (Sluka et al., 2005), excitatory neuromediators. Others, on the other hand, have shown an analgesic effect correlated with opioid activity only with low frequency stimuli (Resende et al, 2004). A-delta fibers also trigger a descending pain-suppressing system in the midbrain (De Domenico 1982; Ainsworth et al, 2006).

High frequency stimulation can also produce a physiological block in both types of peripheral pain fibers, with reduced pain perception (Walsh 1993). However, it is generally believed that the high frequency and low intensity currents stimulate in particular the A-beta fibers and that the low frequency and high intensity currents determine inhibition of the pain typical of the C fibers (Low and Reed). On the other hand, some believe that the effect of TENS is a placebo-only effect induced by the sensation of skin stimulation on the CNS (Oosterhof et al, 2006). Effects on the CNS have always been recently highlighted by Tinazzi et al (2006) who demonstrated a remodulation of the motor cortex after treatment with TENS in patients suffering from writer's cramp. The clinical responses appear to be characterized by an important individual variability. While some studies show analgesic effects in case of acute pain (Thorsteinsson, 1983; Lang et al., 2007), in osteoarthritis of the knee (Law and Cheing, 2004), in lumbago (Gadsby, 2006) and in other chronic pathologies (Kalke et al, 2004) others deny therapeutic effects on chronic low back pain (Khadilkar et al, 2005) or effects not superior to placebo (Deyo et al, 1990; Hermann et al, 1994) even in generic chronic pain (Brena et al. , 1986; Oosterhof et al, 2006). Caroll et al (2000) reviewing the literature on the use of TENS in the treatment of chronic diseases noted the need for further studies. In particular, there are still no data on some aspects considered important for the therapeutic efficacy of transcutaneous electrical waves: type of application, site and duration of treatment, optimal frequencies and intensity of stimuli (Milne et al, 2001).

Also, to meet these needs, a device has recently been proposed which has had its development in the last 20 years in Russia and which uses electrotherapy in a particular modality called SCENAR therapy. The name SCENAR derives from the acronym of Self-Controlled Energo-Neuro-Adaptive Regulation. It is a biphasic, asymmetrically balanced wave with trains of impulses variable as to number and frequency applicable in a precise point or by continuously varying the application

point on a pre-established area (painting). The aim of this work is to evaluate the short-term effect of SCENAR therapy in painful pathologies of the musculoskeletal system.

METHODS AND TOOLS

We took for consideration **253 patients** ranging in age from 18 to 88 years of both genders (151 males and 102 females), practicing and non-practicing sports in most cases at a non-competitive level (118 practitioners, 135 sedentary) carriers of painful pathologies of the musculoskeletal system that presented to our observation both as a first approach and after having undergone other treatments. We have considered both acute and chronic pathologies involving various body segments (see graph 1). Cervical pathologies were mostly outcomes of traumatic distractions (70%), lumbar pathologies were 37% lumbago and 60% lumbosciatica, and shoulder pathologies were mostly rotator cuff tendinopathies with metaplasia calcifies in 30%. In the case of the elbow the pathologies were all epicondylitis. In the forearm and hand region we treated tendinitis for 60% and rhizoarthrosis (Trapeziometacarpal arthritis) for 40% of cases. In the knee area, 38% were involved in particular, arthrosis for 27% and sprains in 19%. As for the ankle, sprains (45% of cases) and tendinitis (55%) and for the foot plantar fasciitis (40% of cases) and metatarsalgia (60%).

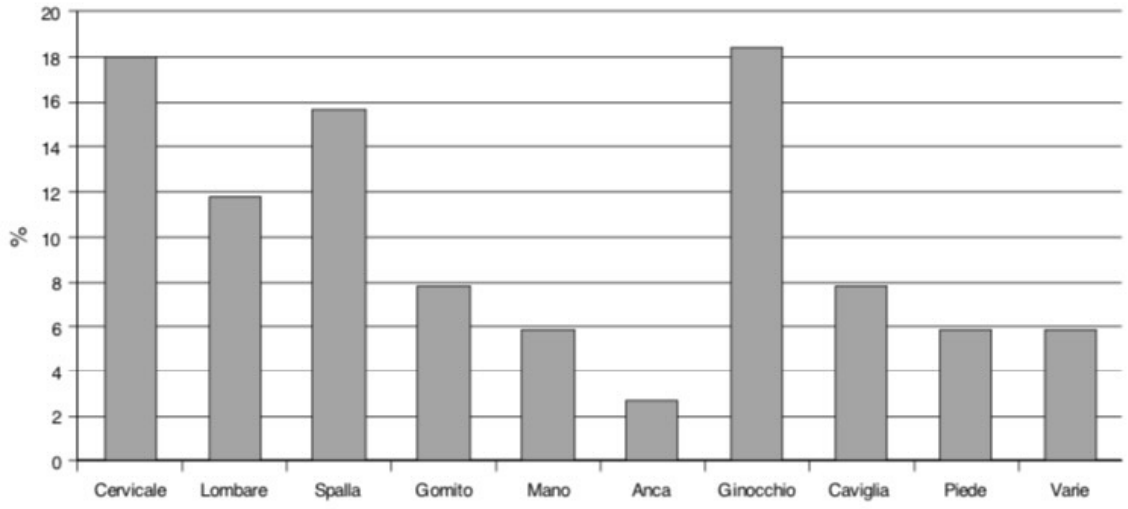

Fig 1: Percentage distribution of the areas affected by the disease

For the therapy we used SCENAR device .The treatment points are established by measuring the initial reaction values (IR) in the DIAG-1 mode. These values depend on the skin impedance. After searching for the point where IR is greater, the reaction of the tissues to the electrical stimulus is assessed, leaving the device's electrode positioned until Dose and Zero symbols appear, indicating the completion of the preparation and availability for treatment. The time required to complete this phase varies from 1 to several minutes. If this phase cannot be completed due to

the appearance of Zero signal before Dose, it is necessary to treat the area in FM mode (frequency modulation) = Sw1 which involves the continuous variation of the frequency from minimum to maximum and of damping, for 1 minute. We move on to the actual treatment by applying the electric waves for 2 minutes with the following SCENAR parameters:

DAMPH (Damping) = Sk2, AM (Amplitude Modulation) = 3: 1, F (Frequency) = 60 Hz, INTENS (Intensity) = 1, Z (Gap) = 10.

If the painful point does not correspond to the treated point, proceed with the same protocol to treat this area.

Then in default mode (DAMPH -off, AM -off, F = 60 Hz, INTENS = 1, Z = 10) we proceed to brushing of the painful area and its dermatome for another 2 min or until the electrode finds more adherence to the skin.

The treatments were performed on alternate days for a number ranging from a minimum of 3 to a maximum of 10 until a satisfactory result was achieved for the patient and the doctor. In some cases, however, it was interrupted by the patient before the 10^{th} treatment due to unsatisfactory results. During the treatment no other therapies were performed while in 25% of cases the therapy was performed after failure of other previous therapies (NSAID treatment or mesotherapy, infiltrations with cortisone, ultrasound, LASER therapy, TECAR therapy, shock waves). The cases that abandoned the treatment after 1-2 sessions, generally due to an increase in painful symptoms (5 cases equal to 1.9%), were not taken into consideration in the statistical elaboration. Pain was detected with Visual Analogue Scale (VAS) with values ranging from 0 to 10, where 0 corresponds to the absence of pain and 10 the most intense pain that the patient deems possible depending on the pathology. Values have been reported to the nearest unit on the scale. The statistical analysis of the data was performed with non-parametric methods due to the asymmetric distribution of the data, in particular the chi-squared test was used (Glantz, 1988).

RESULTS

The number of treatments presented a median of 5 with a variability between the 15^{th} percentile of 3 and the 85^{th} percentile of 6. Initially the median value of VAS was 8 and the final one was 1 (see tab 1).

	Number of treatments	Initial VAS	Final VAS
Median	5	8	1
15^{th} percentile	3	5	0
85^{th} percentile	6	9	4

Tab. 1: Overall results obtained with SCENAR therapy treatment

In particular, if we examined the patients with final VAS of 0 and therefore to be considered totally cured, we observe how they resulted in a number of 73 equal to 28.6% with an average number of treatments of 5 and initial VAS value of 6.

	Number of treatments	Initial VAS
Median	5	6
15th percentile	3	3
85th percentile	6	9

Tab. 2: Number of treatments and initial VAS of the healed patients

Some of these (11 patients) had already undergone other therapies without satisfactory results (iontophoresis, TECAR therapy, cortisone infiltrations, mesotherapy, ozone therapy, shock waves). If we divide the results according to the treated body area (see fig. 2) we can observe how the most evident results concern cervical pathologies, (48%) mostly from traumatic distraction outcomes and the less numerous the lumbar region seat of lumbago and lumbosciatica (14%). The differences were statistically significant at P <0.01 between cervical and lumbar pathologies and at P <0.05 between cervical and other pathologies, on the chi-squared test. There are no significant differences between the other pathologies in terms of cure rate.

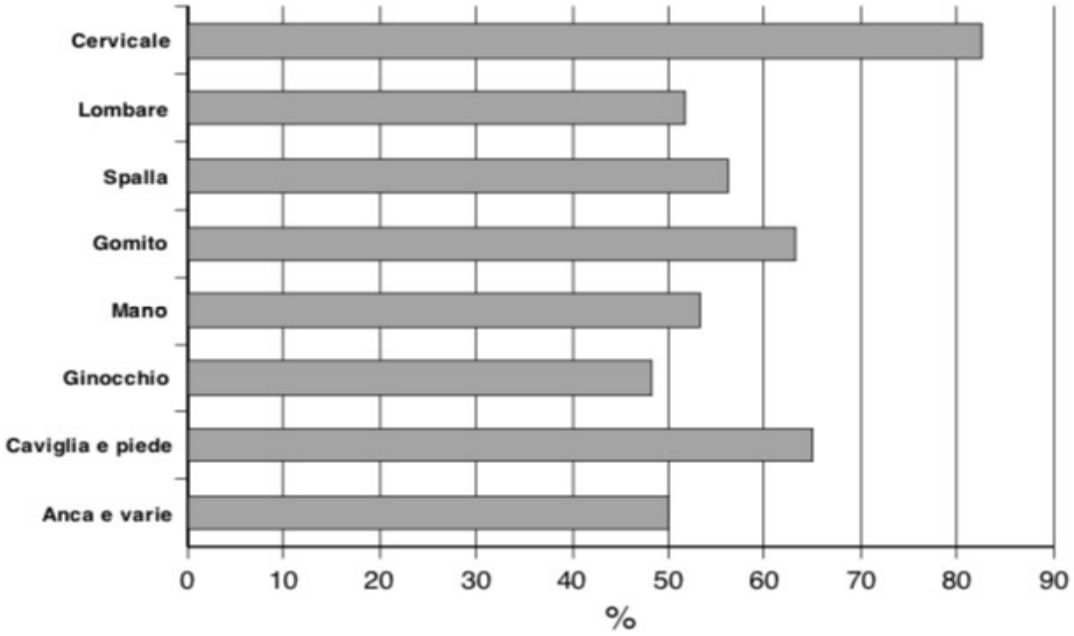

Fig 2. Percentage distribution of cases healed with SCENAR therapy as a function of the body area affected by the disease.

The cases in which there was no improvement with SCENAR treatment were found to be 5 equal to about 2% with an average of 4 treatments and therefore in a situation in which the patients did not want to continue the therapy, presumably disappointed by the first results. There were 3 cases of gonarthrosis (knee arthrosis), one case of epicondylitis and one case of rotator cuff tendinopathy. Those who underwent 10 treatments had an average 6-point improvement on the pain scale, with only one patient having a minimum 1-point improvement in one case of De Quatrain's tendonitis/ tenosynovitis.

If we consider, in addition to the healed, those who presented at the final check-up only a vague pain within the score 1 of the analogue scale and therefore a substantial improvement, we highlight percentages of interesting beneficial effects of the therapy. The group with final VAS of 0-1 was made up of 165 patients equal to about 61% of the sample examined, with variations between the different areas affected by the pathology that favors neck pain over the others (see fig 3), but in all the cases have percentages higher than 50% except for knee pathologies, which however do not differ much from this value.

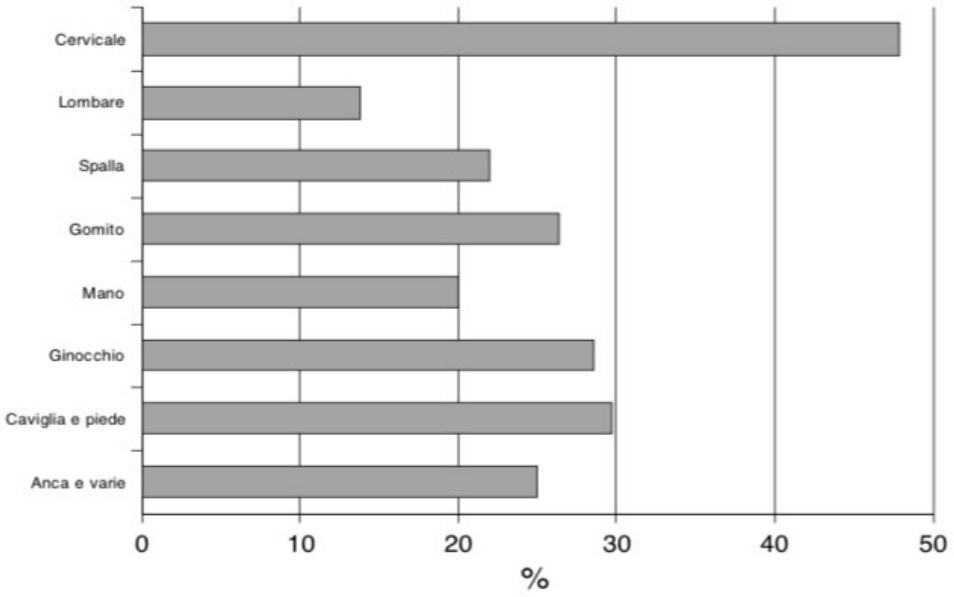

Fig. 3: Percentage distribution of cases treated with SCENAR therapy as a function of the body area affected by the disease that presented final VAS within 1.

If we take into account gender, we can generally observe better results in males than females if we consider VAS at the final assessment, evaluated with the chi-squared test, at P <0.01.

Final VAS	Men		Women	
	Number	%	Number	%
0	56	37.1	17	16.7
1	48	31.8	32	31.4
≥ 2	47	31.1	53	51.9

Tab. 3: Final VAS values after SCENAR therapy treatment in males and females (P <0.01)

On the other hand, there are no statistically significant differences between males and females if we consider the difference between the initial and final values of VAS, (see tab. 4), even if only 5% of males did not benefit from the antalgic action against 10% of females.

Difference between initial and final VAS	Men		Women	
	Number	%	Number	%
0-1	8	5.3	10	9.8
2-3	25	16.5	13	12.8
4-5	38	25.2	30	29.4
6-7	43	28.5	29	28.4
8-10	37	24.5	20	19.6

Table 4: Values of the difference between initial and final VAS after SCENAR therapy treatment in males and females

The comparison between athletes and non-practitioners highlights significant differences in the final values of VAS with better results in sedentary patients, 33% healed against 18% of athletes (see table 5) while comparing the variation in pain as the difference between initial and final VAS does not statistically significant differences were found (see table 6).

Final VAS	Athlete		Sedentary	
	Number	%	Number	%
0	35	40	38	38.1
1	37	26.6	43	31.9
≥ 2	46	33.3	54	40

Tab. 5: Final VAS values after SCENAR therapy treatment in athletes and sedentary patients ($P < 0.05$)

Difference between initial and final VAS	Athlete		Sedentary	
	Number	%	Number	%
0-1	9	8.3	9	6.7
2-3	17	10	21	15.5
4-5	33	25.8	35	25.9
6-7	31	23.3	41	30.4
8-10	28	31.6	29	21.5

Tab. 6: Values of the initial-final VAS difference after SCENAR therapy treatment in athletes and sedentary patients

Final VAS	Treated with other therapy		First treatment	
	Number	%	Number	%
0	8	18.6	65	31.1
1	19	44.2	61	29.2
≥ 2	17	37.2	83	39.7

Tab. 7: Final VAS values after SCENAR therapy treatment in patients already undergone therapy and in first treatment ($P < 0.05$)

Difference between initial and final VAS	Treated with other therapy		First treatment	
	Number	%	Number	%
0-1	3	6.8	15	7.2
2-3	9	20.5	29	13.9
4-5	8	18.2	60	28.7
6-7	11	25	61	29.2
8-10	13	29.5	44	21.0

Tab. 8: Values of the initial-final VAS difference after SCENAR therapy treatment in patient's already undergone therapy and in first treatment

DISCUSSION AND CONCLUSIONS

The pathologies we have considered have different pathogenetic causes with inflammatory and degenerative components, but they have in common the painful symptoms, which is accompanied by a more or less evident functional impotence. As noted by Decocted and Woolf (2006) the causes of pain are different but the reorganization of the pain pathways that produce chronic persistent pain is similar. The mechanisms of pain may be independent of the etiological factors of the pathology. If the stimuli and peripheral nociceptive receptors are different and specific, the response consists, in any case, of the activation of ion channels that through specific protein kinases generate an action potential that is transmitted centrally through the posterior horn of the spinal cord. The repeated stimuli or the continuous production of inflammation molecules (prostaglandins E2, bradykinins, 5HT, growth factors) determine a phenomenon of peripheral sensitization with a reduction in the threshold level and an increase in the action potentials transmitted to the marrow. Also, at the level of the posterior horn, this increase in electrical activity causes, through an increase in amino acids and neurotransmitter neuropeptides, an increase in synaptic activity by acting on the ion channels through phosphorylation reactions under the control of protein kinases. This activity which results in an increase in the perception of pain and enlargement of the painful area is called central sensitization.

Other phenomena include the reduction of the efficacy of the descending inhibition due to downregulation phenomena and the alteration of the genetic regulation of the budding of the low threshold fibers of the Rexed lamina II. All this determines hypersensitivity to pain for which pain can become an anomaly in itself to be treated specifically even in the presence of inflammatory or neuropathic phenomena. The results we obtained with SCENAR therapy are in agreement with this approach to pain assessment and understanding. In fact, the results evaluated both as a final VAS score and as a difference between the initial VAS and the final VAS, are independent of the pathology and the region of the body concerned. The only exception was cervical pain as regards specifically post-traumatic distractions, since cervicobrachialgia caused by hernial protrusion behaved like the other pathologies examined. The extent of the results obtained is also independent of the chronicity of the pathology and the fact of having previously

undergone other physical and pharmacological treatments without satisfactory results. These same data seem to exclude the possibility of a random positive modification, considering that the pathologies examined are almost all spontaneously resolving over time. **However, we must consider the immediate analgesic effect after the session, which is maintained over time in a variable manner from several minutes to several hours until the next session and the rapidity of results on average 5 sessions equal to about 10 days.** We can detect only a significant difference in relation to gender in the initial and final values of VAS with higher values in women to be referred to a greater sensitivity to pain in the female patients in the sample examined. Simmonds et al (1992) also observed a higher pain threshold and greater tolerance in males than in females. In terms of pain symptom improvement with treatment, there are no differences between the genders. This greater sensitivity to pain could depend on the pathologies examined and on the age of the patients, given that a greater number of males were treated, in relation to the more widespread practice of sport in the male gender.

Therefore, the efficacy of SCENAR therapy appears similar in males and females as it is similar in patients practicing sports compared to sedentary ones. It can be assumed that athletes subjecting themselves to greater stresses may still experience painful sensations in the situation in which sedentary people no longer feel them. The results obtained therefore indicate an analgesic effect of SCENAR therapy which is effective even in case of functional overload. **The mechanisms of interruption or alleviation of persistent pain triggered by SCENAR therapy are stable over time at the check-up performed after one month by telephone.** The pathologies considered mostly present the possibility of relapse over time of the degenerative and inflammatory process that generates the painful symptoms with an unpredictable timing. The results obtained also seem to indicate in the pathologies examined an autonomous behavior of persistent pain according to the current hypotheses, which can continue to manifest itself even when the pathological situations have attenuated or disappeared, and which explain the rapid resolution of symptoms sometimes even after a treatment only. The limited cases that do not respond to therapy or the rare cases of accentuation of symptoms in which patients did not want to continue therapy remain unexplained at the present time. However, in these last cases we are not sure that a possible complete treatment cannot generate benefits also in these patients, in fact in some cases we have found initial accentuation and relief of pain only after 4-5 sessions.

On one hand, some cases that did not respond satisfactorily to the therapy after 10 sessions did not respond to other physical and pharmacological therapies except for temporary and partial benefits. We can think that these are the situations in which the most important component is the inflammatory or mechanical compression, as in the case of root compressions, and persistent pain is maintained by continuous stimuli that cannot be controlled by the methods used.

On the other hand, the complexity of the pain mechanisms highlighted by the research but not yet fully known, the differences in the underlying pathology not always evaluable with the techniques currently available, the presence of psychological factors determine a great variability in the response to any therapy. It has been suggested that breaking down pain into components

that reflect major known mechanisms could help understand why some therapies work and others don't (Decosterd and Woolf; 2006).

SCENAR therapy has therefore resulted in our experience as an effective method to control and decrease persistent pain in both sports and sedentary practitioners, proposing itself as a substitute for pharmacological treatments, which can be active even when these have not proved effective. This aspect appears particularly interesting in sports where many athletes, with healthy ideas strictly connected with the practice of sporting activity itself, do not like the use of drugs and where, conversely, the use of drugs for trauma or recurrent pain can generate unwanted drug addiction and organ damage.

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