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ABSTRACT: Fibromyalgia is thought to be prevalent in up to 10% of musculoskeletal complaints. However, objective evidence to rule it out from other conditions is not yet satisfactory. The present study shows that there are EEG spectrum changes in fibromyalgia patients. These changes are reversible with EEG neurofeedback treatment. They are followed by overall symptomatic improvement. The presence of a specific test for differential diagnosis, i.e. EEG pattern predominance may be useful in the field of disability medicine. The medical examiners may use it to rule out the true symptomatic presentations of fibromyalgia from that of simulation or symptom magnification.

KEY WORDS: fibromyalgia syndrome (FMS), myofascitis, myofascial pain syndrome (MPS), EEG spectrum, EEG neurofeedback.

Introduction

Fibromyalgia (FMS) is a syndrome acceptable to the American College of Rheumatology, which has established a set of classification criteria [44]. The prevalence of FMS has been shown in different studies to be between 1 – 10% [12,20]. Despite very serious attempts to identify etiologic and diagnostic parameters that pertain to this syndrome, no specific findings to date rule out most of the FMS presentation from other related conditions [3,31]. This situation makes it difficult for the clinician to investigate and treat, especially because of the overlap and confounding with conditions such as myofascial pain syndrome (MPS) [13]. Myofascial syndromes have been the object of study for several decades [40,41]. There is a definite possibility that fibromyalgia and myofascitis are two clinical presentations at different periods of time within the spectrum of one and the same conditions as yet to be defined. The main differences between the two conditions have been found to be the following:

a) the soft tissue pain is widespread in FMS while being regional and focused in MPS [2];
b) the painful points (tender points) are multiple and spread in a pattern encompassing 18 defined locations according to the ACR criteria in FMS while they are considered trigger points according to specific criteria of referral and few in number, clustered around a specific region in MPS [41,44];
c) the soft tissue pain is occasionally referred in FMS while it is referred according to rather well defined patterns in MPS [41,44];
d) there are taut bands in the regions of the tender or trigger points in both conditions [41,44];
e) there is a twitch response to palpation or triggering which may be found in both conditions [41,44];
f) a perception of chronic fatigue is rather paradigmatic for FMS which is found only occasionally and to a lesser extent in MPS [15,45,47];
g) sleep disturbance with poor sleep and EEG changes may be found in FMS [23] and is hardly found in MPS [17,24,25,27,48];
h) diffuse paresthesias which are not following dermatomal patterns can be found in FMS, while occasional regional paresthesia which

generally follow sclerotomal patterns can be found in MPS [48,49,50];

i) symptoms such as headaches, temporo-mandibular joint pain, irritable bowel and sensation of muscular swelling are found often in FMS and more rarely in MPS [6,10,15,44,48,49,51].

Whereas there are several overlaps between the two conditions, the most distinguishing factor is that of psychological nature. The MPS patients present with no more psychological dysfunction than that found in the general population [11].

Studies of mental stress, anxiety and depression in fibromyalgia show generally comparable values of dysfunction in relation to the general population; however, they suffer from a number of biases related to the referral pattern of the patients [2,13,48]. Perhaps the most interesting finding so far is that the severity of pain in FMS correlates with the psychological dysfunction [49].

The empirical clinical experience of the authors with patients presenting with FMS as compared with patients presenting with MPS is that the former complain of a decreased ability to concentrate, difficulty with short term memory and difficulty to proceed with multi-tasking. The senior author utilized the expression "fibro-fog" for this condition. This is generally not found in patients with MPS.

The hypothesis of the present study is that a successful line of treatment points to the etiology and diagnosis of any condition. In this case, EEG predominant pattern changes were found in fibromyalgia patients with "fibro-fog". When normalized with neurofeedback treatment, most other symptomatic presentation improved to a great or complete extent.

Methodology

The study described below is a retrospective analysis of 252 consecutive referral cases referred during 1996-1997. All the patients were referred by their physicians to a multi-disciplinary clinic located in Calgary, Alberta, Canada. The clinic utilized traditional techniques of physiotherapy and kinesitherapy in addition to advanced electrophysiological techniques of assessment and treatment including surface EMG (sEMG) and EEG spectrum analysis and neurotherapy [16,30,32].

Procedure

All patients had to be referred by their physicians. They all reported that they were diagnosed with fibromyalgia. The reporting met the criteria for the diagnosis as established by the ACR [44].

All the patients received a standard interview by the senior author (clinical psychologist, Ph.D.). The history, complaints and demographic details were recorded. Based on more specific details elicited regarding the complaints, the patients were assigned either a diagnosis of fibromyalgia or myofascitis.

The patients from both groups were assessed further with the following:

a) trigger point evaluation
b) dynamic sEMG evaluation
c) physiotherapy evaluation

The patients from the fibromyalgia group also received

d) an EEG spectrum analysis

This was not conducted on the myofascial group as previous clinical investigations (unpublished) showed no abnormal EEG spectrum pattern was found on EEG spectrum analysis in myofascitis patients.

Rationale For Group Assignment

Assignment to the different groups was based upon the reported symptomatology. The rationale was that fibromyalgia differs from myofascial pain in that with fibromyalgia, the symptoms are more generalized involving all quadrants of the body and affecting the processing capabilities of the Central nervous System (CNS). Thus fibromyalgia was viewed as much more systemic, while myofascial pain was viewed as regionalized. While there is much overlap between the two conditions for the reported pain patterns and, the presence of sleep difficulties, fibromyalgia also involves the presence of "fibro-fog" (decreased ability to concentrate, decreased immediate recall, an inability to multi-task), whereas myofascial pain does not. If the individuals had all of the above problems they were assigned to the fibromyalgia group. If the "fibro-fog" was absent they were assigned to the myofascial group.

> The study shows that a large number of referred patients were initially misdiagnosed. Their physicians misdiagnosed 95 out of 252 referred individuals (i.e. 38%).

Measurements

The trigger point evaluation was conducted by an experienced massage therapist, as outlined by Travell & Simons [41] with the patient demonstrating 4 of 5 criteria. These included:

a) the presence of a taut band,
b) muscle pain in the expected referral pattern,
c) twitch response,
d) localized pain and

Table 1
Demographics

	TOTAL		FM		MYO	
	#	%	#	%	#	%
MALE	53	21	34	21.7	19	20
FEMALE	199	79	123	78.3	76	80
AGE	44.23		44.16		44.36	
RANGE	85-14		80-15		85-14	
PAIN	28.59		29.27		27.29	
RANGE	68-2		63-6		68-2	

Table 2
Cause of Pain

	TOTAL		FM		MYO	
	#	%	#	%	#	%
TRAUMA	134	53.2	78	49.7	56	58.9
VIRAL	27	10.7	23	14.6	4	4.2
STRESS	9	3.6	5	3.2	4	4.2
COMBO	9	3.6	8	5.1	1	1.1
UNKNOWN	73	29.0	43	27.4	30	31.6
TOTAL	252	100.0	157	100	95	100

Table 3
Affected Body Parts

	TOTAL		FM		MYO	
	#	%	#	%	#	%
NONE	3	1.2	2	1.3	1	1.1
HEAD	77	30.6	49	19.4	28	29.5
NECK & SHOULDER	121	48	79	31.3	42	44.2
CHEST	46	18.3	28	11.1	18	18.9
BACK	135	53.6	78	31	57	60
LEGS	70	27.8	44	17.5	26	27.4
ARMS	61	24.2	38	15.1	23	24.2
FULL	55	21.8	47	18.7	8	8.4
UNKNOWN	4	1.6	0	0	4	4.2
SAMPLE	248	98.4	157	100	91	95.8
TOTAL	252	100	157	100	95	100

e) loss of range of motion.

All palpable muscles in the body (except the soles of the feet) were assessed with the total number of trigger points recorded. In addition, the number of hypertonic muscles was recorded. A muscle was considered hypertonic when the therapist could palpate the individual fibers of the muscle (taut band), but pain was not reported. Three results are reported:

a) the number of trigger points found (labeled Trigger Points),
b) the number of hypertonic muscles found (labeled Hypertonic Muscles), &
c) the total of these 2 measurements combined (labeled Total).

The sEMG evaluation followed protocols as outlined by Donaldson & Donaldson [7] and Sella [34, 35, 36, 37, 38]. In this part of the assessment the electrical activity of various pairs of muscles was examined for amplitude, and compared (left side versus right side) for differences in levels of activity. A 20% difference was considered pathological [9,26] and reported as 1 imbalance. A muscle pair was assessed when an active trigger point was located in one of the muscles. The number of pairs of muscles assessed ranged from 9-20 with an average of 12.

The physiotherapy evaluations were conducted by 2 fully qualified physiotherapists following standard neuro-musculoskeletal procedures. For purposes of this study only dysfunctional joints were counted. A dysfunctional joint was defined as such when it was either hypermobile, hypomobile or rotated out of alignment.

The EEG neurotherapy evaluation was that as designed of Ochs [30]. In this assessment electrodes were placed on the scalp following the standard 10/20 locations with a few exceptions. The activity from FP1 and FP2 were combined into one site and labeled as FP. The same process was used for O1 and O2 and labeled as OZ. Sites F7, F8, T5 and T6 were not assessed, thus activity was recorded from 13 sites. Activity was recorded sequentially from each site, starting at FP, then moved in a counter-clockwise fashion around the exterior, then the interior circle finishing at CZ. Data was collected for 2 minutes with the dominant frequencies noted. The dominant frequency was the one which showed the largest amplitude for the time period. This was reported for each of the 13 sites.

Pain Measurements

As part of the assessment the subjects were asked to complete the McGill Pain Questionnaire [22]. They were also asked to complete this during the follow up interview, but so few were returned [68] that this information was not considered valid (all virtually pain free) and was not included in the post treatment analysis. The fibromyalgia group also verbally

completed (talking to the data analyst) a Visual Analogue type rating scale for the symptoms at the time of data analysis. This was a 21-point scale with 11 as the center point. 1-10 indicating an increase in pain and symptoms, 11-21 indicating a decrease in symptoms. The latter group was then debriefed as to the course of their improvement. The time at which this data analysis was completed differed with each patient varying from 3 to 12 months post treatment.

Treatment

Treatment of each group varied dependent upon the results of the assessment. The fibromyalgia group received:

a) physiotherapy,
b) massage therapy,
c) sEMG neuromuscular retraining following the protocol as outlined in Donaldson [8] and Sella [39]. The protocol teaches the patient to increase the activity of muscles showing reduced activity following the procedures as developed by Basmajian for single motor units [1].
d) EEG neurotherapy. The latter therapy used variable frequency photostimulation techniques as developed by Ochs [29].

The myofascial group received the first three treatments, but no EEG neurotherapy.

Post Treatment Evaluations

Evaluations as conducted pre-treatment were not completed as the decision for discharge from the program was based upon ongoing data analysis obtained during treatment. For the myofascial group, if the patient showed fewer than 6 trigger points, fewer than 2 muscle imbalances, improved range of motion and fewer than 2 dysfunctional joints they were discharged from the myofascial program regardless of pain report. For the fibromyalgia group, if they met the above criteria, plus demonstrated normalized dominant frequencies on the EEG, regardless of the reported pain they were discharged.

Data Analysis

All data (except for assignment to group) was collected and analyzed by an individual from outside the clinic, who was blind to the group assignment. Demographic data were collected on all patients. As the dependent variables was ordinal in nature, a frequency count was conducted for each of the measures. This count was divided by the number of patients in that cell converting it into a ratio (percentage). The ratios were examined for differences and trends.

Results

Classification

Although all subjects were referred with the diagnosis of fibromyalgia, of the 252, only 157 were deemed to have fibromyalgia. The remainder [95] were deemed to be suffering from a myofascial pain syndrome. This conclusion was primarily reached on the basis of the reported pain (i.e., regional arm pain bilateral in nature but no other pain, nor sleep or mental processing problems). In those cases where the pain was more generalized but no sleep problems nor mental processing problems were noted, these individuals were assigned into the myofascial category. Thus entrance into the fibromyalgia group was restricted to those individuals who meet the ACR criteria plus reported sleep and mental processing problems.

Subjects' Demographics

Table 1 reports the demographics of the total sample and for each group. The average age of the sample was 44.2 years (range 14-85) with 80% female. This is consistent with data from other studies [12,20]. The fibromyalgia group reported being in pain longer, but otherwise there were no significant differences between groups. The level of pain as reported on the McGill Pain Questionnaire was a total score of 29.3 (range 6-63) for the fibromyalgia group and 27.3 (range 2-68) for the myofascial group. This is summarized in Table 1.

The patients were asked to identify the cause of the problem. Approximately 30% were unable to give a clear answer. The remainder reported as causes of the dysfunction: a) trauma, b) viral, c) stress and d) a combination of the above. As can be seen in Table 2 almost half the fibromyalgia patients reported trauma as the source of their problem. There is also a significantly higher percentage that reported viral as a cause in the fibromyalgia group as opposed to the myofascial group.

The patients were also asked to identify the parts of their body that were causing them pain. As may be seen in Table 3 the myofascial group reported affected body parts in every part of the body. The fibromyalgia group reported the whole body was affected more often.

Table 4 illustrates the findings in regard to sleep problems with over 76% of the fibromyalgia group and 49.5% of the myofascial group reporting problems. As may be seen for the fibromyalgia group, frequent awakening during the night was the most frequently reported problem.

Trigger Point Data

The fibromyalgia group demonstrated a higher number of trigger points, hypertonic muscles and the two combined (total) than the myofascial group. This included a higher average in each case and a wider range. Table 5 summarizes this data.

sEMG Data

Table 6 illustrates that the fibromyalgia group showed a slightly higher total number of imbalances than the myofascial group. However, the range is similar for both groups.

Table 4
Sleep Disorders by Group

	TOTAL		FM		MYO	
	#	%	#	%	#	%
NO PROBLEM	58	23	23	14.6	35	36.8
SLEEP PROBLEM	167	66.3	120	76.4	47	49.5
T.F.A	66	26.2	49	31.2	17	17.9
F.W.N.	126	50	94	59.9	32	33.7
F.E.W.	59	23.4	45	28.7	14	14.7
D.G.S.U.O.B.	61	24.2	45	28.7	16	16.8
N.R.S.	122	48.4	90	58	32	33.7
F.A.D.D.	15	6	14	8.9	1	1.1
F&L	95	37.7	74	47.1	21	22.1
SAMPLE	233	92.5	149	94.9	84	88.4
UNKNOWN	19	7.5	8	5.1	11	11.6
TOTAL	252	100	157	100	95	100

LEGEND
T.F.A. = Trouble Falling Asleep, F.W.N. = Frequent Waking in the Night, F.E.W. = Frequent Early Waking, D.G.S.U.O.B. = Difficulty Getting Self Up and Out of Bed, N.R.S. = Non-restorative Sleep, F.A.D.D. = Fall Asleep During the Day, F&L = Fatigued and lethargic

Table 5
Total Number of Trigger Points and Hypertonic Muscles

	Average	Range	Sample	Unknown	Total
T.P.T.	17.3	56-0	169	83	252
T.P. FM	18.6	56-2	128	29	157
T.P. MYO	13.5	37-0	41	54	95
H.T.	9.1	32-0	169	83	252
H. FM	10.1	32-0	128	29	257
H. MYO	6.0	20-0	41	54	95
C.T.	26.2	56-2	169	83	252
C.FM	28.6	56-8	128	29	157
C.MYO	18.2	39-2	41	54	95

LEGEND
T.P.T. = Trigger Points Total, T.P.FM = Trigger Points Fibromyalgia T.P. Myo = Trigger Points Myofascial, H.T. = Hypertonic Total, H. FM = Hypertonic Fibromyalgia, H. Myo = Hypertonic Myofascial, C.T. = Combined Totals, C.FM. = Combined Fibromyalgia, C. Myo = Combined Myofascial

Table 6
Number of Muscle Imbalances

	Average	Range High	Low	Sample
TOTAL	8.6	14	0	165
FM	27	14	0	126
MYO	9	14	0	39

When the sEMG data was examined by site, the fibromyalgia group demonstrated a significantly higher number of dysfunctional muscles in the neck and low back/buttocks region. The data pertaining to the neck is consistent with that as reported in the literature [5] and are highlighted in Table 7.

Physiotherapy Data
The average number of dysfunctional joints for each group was 9.8 (range 0-20) for the fibromyalgia group and 7.5 (range 0-15) for the myofascial group. The dysfunctional joints were primarily located in the cervical region and S1 joints.

EEG Neurotherapy
The dominant frequency for each of the sites was established as outlined above. There was considerable overlap between theta (3.5 – 7.5 Hz) and alpha (7.5 – 12.5 Hz) with some of the dominant frequencies distributed in the 6 to 10 Hz range (Theta/alpha). Theta was found to be dominant 28.1% of the time, alpha 14.3%, and Theta/alpha 17.3%. Analysis by site showed these slow wave frequencies dominant at 8 of the 13 sites measured including FP, F3, FZ, F4, C3, CZ, C4 and PZ. No dominant frequencies were found at the rest of the sites, but it was noted that the slow wave patterns were second highest at all other sites but one (P4). Delta (2 – 3.5 Hz) and Beta [12 – 15.5 Hz (labeled as SMR) and < 16 Hz (labeled as Beta)] activity was markedly decreased. The data is highlighted in Table 8.

Treatment Outcome

Fibromyalgia Group
At the time of the data analysis, 25 patients were still in treatment, 44 had completed treatment (met the criteria for discharge listed above), 64 were on a waiting list, 21 declined treatment (primarily due to cost) and 3 were transferred to a related clinic in another city. Of the 44 who had completed treatment, on the VAS verbal report scale, 4 indicated they got worse with treatment. The remainder (40) indicated they had improved. These results are highlighted in Figure 1.

Examination of Figure 1 reveals a trimodal distribution with 1 subgroup worse, 1 subgroup marginally improved and 1 subgroup significantly improved. Examination of the patient's records revealed that for the subgroup that got worse there were interaction problems with the medications they were on, or they had an undiagnosed medical problem. The group that marginally improved tended to have a viral infection as the cause, while the significantly improved group tended to be post-trauma.

Discussion with the patients indicated that there was a pattern to their recovery (see Figure 2). The improvement in all cases was gradual with the rate of change idiosyncratic. However, in all cases, the "fibro-fog" lifted first (generally

within 20 days from the start of treatment), with the pain changing from being general in nature to site specific. This led to an interesting pattern in which they perceived the pain as decreased in distribution, but increased in intensity. Emotional factors decreased around 20 to 30 days after the start of treatment, fatigue decreased in 1 to 2 months and sleep improved in 2-3 months. Concurrently they reported a gradual decrease in the specific pain, and improvement in range of motion and muscle function. The previously stated criterion for discharge was met by 80% of the patients within 4 months and the remainder within 6 months from the start of treatment.

Myofascial Group

Of the 95 who were viewed as suffering from myofascial pain, 30 completed treatment meeting the discharge criteria listed above. Of the 30 patients, at the time of discharge (any time from July 1, 1996 to June 30, 1997), 23 reported significant improvement (defined as virtually pain free), while 5 reported no change in pain and 2 stated the pain was made worse. Of the remainder, 16 were still in treatment, 7 stopped treatment due to financial reasons, 10 were assessed only, and 40 did not proceed into treatment due to financial reasons. Figure 3 illustrates these results.

Table 7
EMG Imbalances by Group

	TOTAL		FM		MYO	
	#	%	#	%	#	%
TEMPOR	0	0	0	0	0	0
MASSET	18	7.1	11	7	7	7.4
SCM	131	52	108	68.8	23	24.2
CPS	112	44.4	88	56.1	24	25.3
UTRAP	119	47.2	96	61.1	23	24.2
PECMAJ	69	27.4	58	36.9	11	11.6
PECMIN	38	15.1	30	19.1	8	8.4
SERANT	56	22.2	45	28.7	11	11.6
LATISS	68	26.6	57	36.3	10	10.5
SSPINA	55	21.8	47	29.9	8	8.4
ISPINA	104	41.3	84	53.5	20	21.1
ANTDELT	6	2.4	4	2.5	2	2.1
POSTDELT	3	2.1	1	0.06	2	2.1
MIDTRAP	2	0.8	2	1.3	0	0
LEVSCAP	82	32.5	67	42.7	15	15.8
LTRAP	121	48	100	63.7	21	22.1
SCALENE	72	28.6	60	38.2	12	12.6
FLEX	8	3.2	5	3.2	3	3.2
EXTEN	6	2.4	2	1.3	4	4.2
TPARA	14	5.6	11	7	3	3.2
LPARA	23	9.1	18	11.5	5	5.3
QUAD	88	34.9	66	42	22	23.2
GLUTMAX	90	36	69	43.9	21	22.1
GLUTMED	91	36.1	74	47.1	17	17.9
ILLIO	75	29.8	56	35.6	17	17.9
TFL	10	4	7	4.5	3	3.2
OTHER	13	5.2	8	5.1	5	5.3

LEGEND
Tempor = Temporalis, MASSET = Masseter, SCM = Sternomastoids, CPS = Cervical Paraspinals, UTRAP = Upper Trapezius, PECMAJ = Pectoralis Major, PECMIN = Pectoralis Minor, SERANT = Serratus Anterior, LATISS = Latissismus Dorsi, SSPINA = Supraspinatus, ISPINA = Infraspinatus, ANTDELT = Anterior Deltoid, POSTDEL = Posterior Deltoid, MIDTRAP = Middle Trapezius LEVSCAP = Levator Scapula, LTRAP = Lower Trapezius, SCALENE = Scalene, FLEX = Wrist Flexors, EXTEN = Wrist Extensors, TPARA = Thoracic Paraspinals, LPARA = Lumbar paraspinals, QUAD = Quadratus Lumborium, GLUTMAX = Gluteus Maximus, GLUTMED = Gluteus medius, ILLIO = Illiosposis, TFL = Tensor Fascia latus

Discussion

This present study is retrospective in nature and as such statistical analysis of the data was not conducted as no 'a priori" hypotheses were tested. However, there are several items of interest, which emerge from the data.

There is in the literature evidence of considerable overlap between the two diagnostic groups. This was evident in this study. Both groups showed a similar number of joint problems and muscle imbalances, but the fibromyalgia group showed a much higher number of trigger points and hypertonic muscles. This could be due to the difference in length of time in pain, but could also be due to CNS involvement as opposed to peripheral nervous system involvement. This needs further investigation.

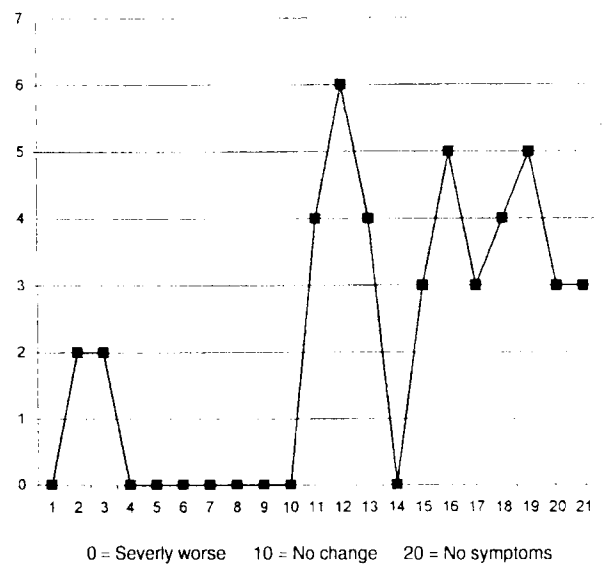
As expected, the reported pain patterns of the myofascial group were quite specific, whereas in the fibromyalgia group the reported involvement was that of the whole body. It is possible that the increased number of trigger points caused this, but it could also be a perceptual issue in that the overall pain obscures the specific problems. This latter point is supported by the progress reports from the successfully rehabilitated patients, in which the pain moves from general to specific, increasing in intensity at the sites. The work of Scudds [33] further supports the impression that it is a perceptual issue.

The study shows that a large number of referred patients were initially misdiagnosed. Their physicians misdiagnosed 95

Table 8
EDS Results by Dominant Frequency by Site

Site	None	Delta	Theta	Alpha	SMR	Beta	T/A	Mixed
FP	28	0	57	16	0	2	34	10
F3	35	0	54	19	0	2	27	10
FZ	18	0	55	17	0	3	42	12
F4	35	0	52	22	0	2	28	8
T3	41	0	33	18	0	18	20	17
C3	30	1	48	22	1	5	30	10
CZ	22	0	53	23	2	2	34	11
C4	40	0	38	23	0	2	29	15
T4	40	0	39	13	0	11	21	23
P3	39	0	36	28	2	7	22	13
PZ	27	0	40	32	2	5	27	14
P4	44	0	33	26	2	1	22	19
OZ	42	0	36	32	0	5	17	15
TOTAL	441	1	574	271	9	65	353	177
%	21.6	0.1	28.1	14.3	0.4	3.2	17.3	8.67

Figure 1
Outcome for Fibromyalgia Patients



out of 252 referred individuals (i.e. 38%). This points out the need of strict diagnostic criteria for both syndromes, criteria that need to be well taught to primary care and other physicians. It is easy to understand that misdiagnosis may bring about an insufficient or inadequate treatment and, of course, poor results.

While it would have been desirable to conduct EEG assessments on the myofascial group, this was not done due to previous clinical results, ethical considerations and financial restrictions. Clinical observations (by all authors) indicate that the dominance of slow wave activity is absent or not as extensive in the myofascial group. The treatment outcome data for this group supports this position. None of the myofascial group received EEG neurotherapy, but a significant number of these patients improved to the point of being virtually symptom free. Prior to this study, the authors had attempted to treat the fibromyalgia populace with similar techniques as for the myofascial populace. The results were discouraging with most of the fibromyalgia patients reporting little or no improvement. It was also noted that these patients would respond initially to treatment, then not progress. This pattern was changed with EEG neurotherapy. Altering the EEG spectrum appeared to alter the body's response to treatment. One-year follow-ups of these patients receiving EEG neurotherapy revealed similar outcome results (unpublished) as what are reported in this study.

It is important to recognize the "fibro-fog" as a symptomatic cluster that is quite relevant and specific in the recognition of fibromyalgia. If necessary, primary care physicians need to refer patients who present with CNS dysfunction in the presence of diffuse soft tissue pain. The EEG spectral assessment was paramount to the specific diagnosing and treatment of the fibromyalgia group. The data shown in this paper demonstrate that the EEG dominance of slow wave activity is not a spurious finding. It is for that matter the test that allows for the most specific differential diagnosis of fibromyalgia to date. If this were not the case, the treatment with the neurotherapy would not have resulted in a "normalized" brain wave pattern and associated changes in terms of pain trigger points, improvements in mental status and sleep. Thus, the slow wave dominance may be interpreted as the most specific paradigm found to date in this condition. The treatment results clearly demonstrated its relevance. Mueller [28] has also demonstrated the change that occurs in psychological status and symptomatology as a consequence of treatment identical to that outlined above, further supporting this conclusion.

The increased presence of frontal slow wave activity in the fibromyalgia group is interesting as this phenomena is reported in the literature by Westmoreland [43] for various viral caused diseases (i.e. measles). While the noted

literature is for viral infections, the slow wave phenomena is commonly reported for other conditions (i.e. allergies, toxic poisoning, post trauma, especially whiplash) as well (personal communication Dr. L. Ochs – December 29, 1997). More recently this phenomen has been reported by Billiot, Budzynski & Andrasik [4] in a sample of chronic fatigue patients. {Note: Most CFS patients also meet diagnostic criteria for FMS}

Fibromyalgia patients typically complain of significantly disturbed and unrefreshing nonrestorative sleep [14,46] resulting in persistent fatigue and reduced cognitive functioning. Research has shown that the nonrestorative sleep of fibromyalgia patients is associated with a physiologic EEG arousal disorder during sleep, wherein bursts of prefrontal and central alpha waves (7.5 – 12.5 Hz) intrude on the primarily slow delta wave (0.5-2 Hz) EEG activity associated with deep, Stages 3 & 4, non-REM, slow wave sleep [18, 21, 26], thus depriving healthy persons of slow-wave sleep which may induce fibromyalgia symptoms of muscle pain, fatigue and cognitive clouding [27]. A number of research studies have shown that the intensity of delta activity in sleep is greatest in the frontal regions of the brain and that a lack of Stages 3 & 4 – slow wave sleep – negatively effects frontal lobe cerebral functioning primarily. Frontal lobe hypoactivity during the waking state is associated with such symptoms as an inability to focus on tasks, distractibility, emotional flattening, lack of spontaneity, and stereotyped thinking [19]. The EEG spectrum data, in terms of both the frequency distribution and affected sites, further support the research and, extend it to the waking state.

The dominance of slow wave activity particularly alpha is also seen when the brain is not active or "idling" (Personal communication – Dr. Robert Thatcher – January 24, 1998) due to the lack of stimulation from the thalamus. The thalamus acts as a quarterback orchestrating the sensory input directing the input to the appropriate areas of the brain.

Repeated stimulation of the thalamus by sensory input (i.e. pain) causes a recruitment response by the thalamus. The effect of the recruitment response is to summate the thalamic response to the pain creating a larger and larger response, drawing in more and more of the available thalamic cells. It is speculated that eventually this process causes the thalamus to become gridlocked reducing the sensory input to the cortex and producing the slow wave (alpha) activity seen in the cortex. As the basal ganglia lay immediately adjunct to and around the thalamus it is possible that the increased activity of the thalamus affects the basal ganglia producing the generalized pain patterns. While the recruitment response of the thalamus is well documented, as is the alpha activity of the "idling" brain, the remainder of the above theory needs to be investigated.

Figure 2
Treatment Timeline

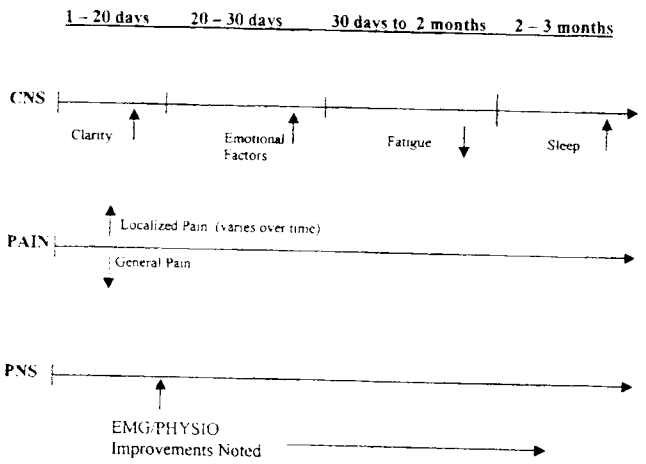
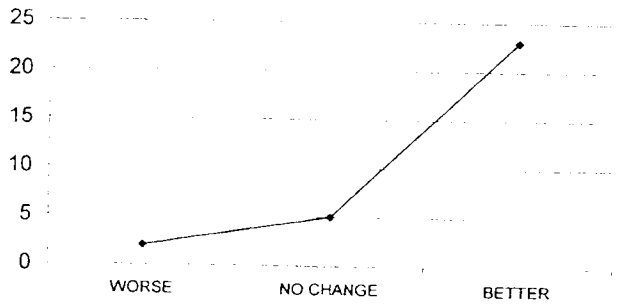


Figure 3
Outcome for Myofascial Patients



The presence of objective evidence is the sine qua non parameter need of the disability medicine specialist/ independent medical examiner. Up to the present time, the symptomatic presentation of fibromyalgia from the disability medicine point of view suffered, to say the least, from lack of specificity in terms of objective diagnostic work-up. Controversial studies results were compounded by the various medico-legal agendas. The presence of an objective diagnostic mean, i.e. EEG spectrum pattern predominance, is hopefully the parameter that allows for the recognition of this condition as true and existent, when that is the case. The strength of this objective finding is further reinforced by the temporal facts, which show the following:

a) neurofeedback changes the EEG pattern to one of non-wave-dominance,
b) symptomatic improvement in the mental status and perception of pain follow the EEG "normalization".

The disability-evaluating physician may derive new knowledge and ability from the data described in the study. For instance, the status of maximum medical improvement in fibromyalgia may not be assigned until:

a) the EEG testing is done,
b) the theta or theta/low alpha predominance is found,
c) neurofeedback treatment is given until the EEG pattern normalized and symptoms reach a plateau within 3-6 months of combined neurofeedback,
d) sEMG biofeedback and other myofascial type treatment.

Furthermore, guidelines need to be established and acknowledged, concerning the clinical parameters of utilization of EEG neurofeedback and sEMG biofeedback in the general field of disability medicine. Such parameters are paramount to the disability related diagnostic process of fibromyalgia and myofascitis. The above parameters are objective, repeatable and reliable in the hands of trained clinicians. The establishment of permanent percentage of impairment in the field of soft tissue pathology awaits the utilization of such objective parameters.

Summary

Successful resolution of complex health problems such as fibromyalgia points to possible etiological factors. Clinical data is presented on 252 consecutive referrals with the diagnosis of fibromyalgia. Of these 95 were deemed to have a myofascitis syndrome. The data collected included trigger point and hypertonic muscle activity, sEMG muscle imbalances, joint dysfunction and EEG spectral analysis of the dominant frequency of 13 sites in the brain. While the overlapping of the results between groups was extensive, successful resolution of the fibromyalgia symptoms was obtained only after a combined program, which integrated EEG neurotherapy into the treatment. It is suggested that fibromyalgia differs from myofascitis through CNS involvement in the former. The disability-evaluating physician needs to be cognizant of this factor when evaluating these conditions.

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