EMOST™ method and neurological (brain) and neurological associated disorders

LFI-EMF treatments and developments should get more possibility and attention in the application of biophysical treatment of diseases in the future

1. Biophysical low-frequency and intensity electromagnetic fields /treatments

Although pharmacology has made considerable progress in the treatments of various diseases, we should also recognize that in numerous cases pharmacology treatments are ineffective. In these cases, the application of biophysical low-frequency and intensity electromagnetic fields /treatments (LFI-EMFs) can offer new opportunity, because during diverse diseases, living cells not only display altered biochemical processes but also produce altered non-linear bioelectric and bioelectromagnetic complex patterns. It is very possible that the major efficiency of low-frequency and intensity electromagnetic fields (LFI-EMF) treatments is due to the redox processes and the bidirectional communication between skin cells and the nervous system.

2. Costs for brain disorders

In 2005, Patrik Andlin-Sobocki et al. presented for the first time overall estimates of annual costs for brain disorders (mental and neurologic disorders) in Europe (Table 1).

In 2007, WHO showed that neurological disorders, (epilepsy, headache, stroke, brain injuries, neuroinfections, multiple sclerosis, Parkinson disease, Alzheimer disease, stress, depression, burn-out, panic etc.) affect up to one billion people worldwide. For example, 50 million people suffer from epilepsy and 24 million from Alzheimer and other dementias worldwide. Neurological disorders affect people in all countries, irrespective of age, sex, education or income. According to World Health Organization (WHO) data, brain disorders were estimated to represent 35% of the total burden of all diseases in Europe. This suggests that the cost of brain disorders in Europe is very high. It was estimated that 6.8 million people die as a result of neurological disorders every year. In Europe, the economic cost of neurological diseases was estimated at about 139 billion euros in 2004.* WHO advocated for the integration of neurological care into primary health care. For many people, primary health care is the only access to medical care they have. In these settings, doctors can use low-technology interventions. Community-based rehabilitation is also an option.
http://www.who.int/mediacentre/news/releases/2007/pr04/en/index.html

In 2010, (*Olesen J, Gustavsson A, Svensson M, Wittchen HU, Jönsson B; CDBE2010 study group; European Brain Council. Collaborators (70)*) presented an updated, more accurate, and comprehensive estimates for 30 European countries (Table 2). This study showed (that the previous study grossly underestimated the cost of brain disorders) that the total cost of brain disorders (mental and neurologic disorders) in Europe in 2010 was € 798 billion. Direct health care cost was 295 billion, non-medical cost (nursing homes etc.) 186 billion, and the indirect cost (absenteeism from work, pensions etc.) 315 billion. This high cost of brain disorders may be surprising, but WHO data suggest that brain disorders cause one-third of the burden of all diseases and are thus in agreement with the present study [3]. , The total cost of brain disorders in Europe in 2010, € 798 billion, is comparable to the cost of cardiovascular diseases, cancer, and diabetes put together. Furthermore, the prevalence and

cost of brain disorders are going to increase because of increasing life expectancy. In particular, the number of patients with neurodegenerative disorders, stroke, depression, and anxiety will increase. Increased focus on research strategies, prevention, and care is necessary to reduce the future cost of brain disorders. brain disorders are the biggest health challenge of the century posing a serious threat to our social and health care systems as well as to the future of European economy.

Table 1 Global burden of disease study results

	Global			EU25			EU15			EU10		
Groups	Total	Per 1000	%	Total	Per 1000	%	Total	Per 1000	%	Total	Per 1000	%
Mental	191 660 642	30.8	12.9%	14 857 720	32.8	25.3%	12 379 282	32.7	26.3%	2478 438	33.27	21.16%
CVD	138 013 023	22.2	9.3%	10 088 093	22.2	17.1%	7637 493	20.1	16.2%	2450 599	32.90	20.92%
Cancer	77 152 633	12.4	5.2%	9839 035	21.7	16.7%	7989 864	21.1	16.9%	1849 172	24.82	15.78%
Injuries	182 590 897	29.3	12.2%	5099 011	11.2	8.7%	3644 620	9.6	7.7%	1454 392	19.52	12.41%
Respiratory	55 059 995	8.9	3.7%	3523 243	7.8	5.9%	3167 675	8.4	6.7%	355 568	4.77	3.04%
Digestive	46 300 182	7.4	3.1%	2925 351	6.5	4.9%	2205 780	5.8	4.7%	719 571	9.66	6.14%
Musculoskeletal	28 349 766	4.6	1.9%	2563 271	5.7	4.4%	1994 910	5.3	4.2%	568 362	7.63	4.85%
Infections	462 516 353	74.3	31.0%	2282 694	5.0	3.9%	1849 365	4.9	3.9%	433 329	5.82	3.70%
Nutrition/End	61 520 078	9.9	4.1%	2390 372	5.2	4.0%	2042 736	5.4	4.3%	347 636	4.67	2.97%
Sense organs	69 379 818	11.2	4.7%	2868 843	6.3	4.9%	2248 811	5.9	4.8%	620 032	8.32	5.29%
Maternal	128 884 629	20.7	8.6%	725 905	1.6	1.2%	593 440	1.6	1.2%	132 464	1.78	1.13%
Oral	7 372 021	1.2	0.5%	434 767	0.9	0.7%	343 829	0.9	0.7%	90 937	1.22	0.78%
Urinary	15 213 854	2.4	1.0%	601 238	1.3	1.0%	498 616	1.3	1.0%	102 622	1.38	0.88%
Congenital	27 402 428	4.4	1.9%	608 304	1.3	1.0%	496 447	1.3	1.0%	111 857	1.50	0.95%
Total	1 491 416 317	239.6	100%	58 807 846	129.7	100%	47 092 868	124.2	100%	11 714 978	157.26	100%

Note. EU25 refers to all EU member states, EU15 refers to the EU member states before 2004 and EU10 refers to the EU member states in the European monetary union.

Table 1 Source: Costs of Disorders of the Brain in Europe. 2005 Guest Editors: Patrik Andlin-Sobocki, Bengt Jönsson, Hans-Ulrich Wittchen and Jes Olesen. **European Journal of Neurology** 12 (Suppl. 1).

Table 2. Number of subjects affected and cost of brain disorders in Europe by diagnostic group and selected specific diagnoses

		Cost per patient (€PPP 2010)				Total costs (million €PPP 2010)			
Disorders	Estimated number of subjects affected (millions)	Direct health care costs	Direct non-medical costs	Indirect costs	Total	Direct health care costs	Direct non-medical costs	Indirect costs	Total
Addiction	15.5	1782	873	1572	4227	27 685	13 569	24 430	65 684
Alcohol dependence	14.6	1689	922	1671	4281	24 596	13 430	24 336	62 361
Opioid dependence	1.0	3176	143	98	3416	3089	139	95	3323
Anxiety disorders	69.1	670	2	405	1077	46 267	144	27 969	74 380
Agoraphobia	8.8	337	0	760	1097	2959	0	6675	9634
GAD	8.9	988	0	226	1214	8786	0	2014	10 800
OCD	2.9	555	0	225	779	1617	0	656	2272
Panic disorder	7.9	844	0	661	1505	6670	0	5224	11 894
PTSD	7.7	1064	19	0	1082	8241	144	0	8385
Social phobia	10.1	721	0	476	1196	7277	0	4806	12 083
Specific phobia	22.7	472	0	378	850	10 717	0	8595	19 312
Brain tumor	0.2	13 387	0	8203	21 590	3208	0	1966	5174
Child/Adolescent disorders	5.9	439	3156	0	3595	2601	18 724	0	21 326
ADHD	3.3	477	304	0	781	1555	992	0	2546
Autism	0.6	1255	26 006	0	27 261	695	14 413	0	15 109
Conduct disorder	2.1	166	1569	0	1735	352	3319	0	3671
Dementia	6.3	2673	13 911	0	16 584	16 949	88 214	0	10 5163
Eating disorders	1.5	400	48	111	559	593	70	164	827
Anorexia	0.8	710	80	188	978	583	65	154	803
Bulimia	0.7	15	8	15	38	10	5	10	25
Epilepsy	2.6	2461	625	2136	5221	6503	1653	5644	13 800
Headache	152.8	59	0	226	285	9039	0	34 475	43 514

Medicine overuse headache	8.3	305	0	1986	2291	2533	0	16 503	19 037
Migraine	49.9	84	0	286	370	4181	0	14 282	18 463
Other headaches	10.2	33	0	24	57	333	0	249	582
Tension type headache	84.4	24	0	41	64	1991	0	3441	5433
Mental retardation	4.2	6970	3364	0	10 334	29 204	14 097	0	43 301
Mood disorders	33.3	781	464	2161	3406	26 016	15 437	71 952	11 3405
Bipolar disorder	3.0	622	560	6002	7183	1860	1675	17 956	21 491
Major depression	30.3	797	454	1782	3034	24 156	13 762	53 996	91 914
Multiple sclerosis	0.5	9811	8438	8725	26 974	5295	4554	4709	14 559
Neuromuscular disorders	0.3	7133	5641	17 278	30 052	1834	1450	4442	7726
ALS	0.1	11 240	11 559	4665	27 463	596	613	247	1457
CIDP	0.0	15 507	2746	3759	22 012	223	40	54	317
GBS	0.0	51 682	0	2319	54 001	342	0	15	358
MMN	0.0	15 507	2747	3759	22 012	40	7	10	57
Muscular dystrophies	0.1	1320	5547	30 186	37 053	177	744	4050	4972
Myasthenia gravis	0.0	9124	779	1111	11 014	375	32	46	453
PDN	0.0	15 507	2746	3759	22 012	80	14	19	113
Parkinson's disease	1.2	5626	4417	1109	11 153	7029	5519	1386	13 933
Personality disorders	4.3	773	625	4929	6328	3342	2701	21 301	27 345
Antisocial PD	2.0	561	0	2737	3297	1118	0	5458	6576
Borderline PD	2.3	956	1161	6809	8925	2224	2701	15 843	20 769
Psychotic disorders	5.0	5805	0	12 991	18 796	29 007	0	64 920	93 927
Sleep disorders	44.9	441	0	348	790	19 796	0	15 630	35 425
Hypersomnia	3.1	820	0	458	1278	2562	0	1430	3992
Insomnia	29.1	153	0	0	153	4465	0	0	4465
Narcolepsy	0.1	1851	0	3784	5635	170	0	347	516
Sleep apnea	12.5	1008	0	1109	2117	12 599	0	13 853	26 452
Somatoform disorder	20.4	468	0	570	1037	9547	0	11 622	21 169
Stroke	8.2	5141	2035	599	7775	42 352	16 769	4932	64 053
Stroke (incident)	1.3	13 850	5534	1616	21 000	17 570	7021	2050	26 641
Stroke (prevalent)	7.0	3556	1399	413	5368	24 782	9748	2882	37 412

Table 2. (Continuited)

Disorders	Estimated number of subjects affected (millions)	Cost per patient (€PPP 2010)				Total costs (million €PPP 2010)			
		Direct health care costs	Direct non-medical costs	Indirect costs	Total	Direct health care costs	Direct non-medical costs	Indirect costs	Total
Traumatic brain injury	3.7	2697	893	5219	8809	10 106	3348	19 560	33 013
Trauma (incident)	1.2	4158	52	4156	8366	5023	62	5021	10 106
Trauma (prevalent mod/sev)	2.5	2002	1294	5725	9020	5083	3285	14 539	22 907
Total	Number of diagnoses 380.1					296 374	18 6250	315 101	797 725

GAD, generalized anxiety disorder; OCD, obsessive-compulsive disorder; PTSD, post-traumatic stress disorder; ADHD, attention deficit hyperactivity disorder; ALS, amyotrophic lateral sclerosis; CIDP, chronic inflammatory demyelinating polyradiculoneuropathy; GBS, Guillain–Barré syndrome; MMN, multifocal motor neuropathy; PDN, paraproteinemic polyneuropathies; PD, personality disorder.

Table 2. Source: Olesen J, Gustavsson A, Svensson M, Wittchen HU, Jönsson B; CDBE2010 study group; European Brain Council. Collaborators (70) The economic cost of brain disorders in Europe. Eur J Neurol. 2012 19(1):155-62

3. EMOST method and natural-based electromagnetic signal forms

EMOST™ medical device (Figure 1) can detect non-linear bioelectric and bioelectromagnetic signals (as ECG or EEG signals) from subjects' skin by unique flat input/output electrodes (Figure 3). The collected signals are processed by computer of EMOST™ apparatus. The subjects are treated by processed signals originated from apparatus

(signal density between 1 Hz - 1 MHz; intensity range is in natural pA mV). A particular feature of EMOST™ method - compared to most of electromagnetic equipments - is that the subjects' own bioelectro- bioelectromagnetic signals that are detected from skin can be processed in natural analogue mode (non-digitalized). Next, analogue signals are radiated back, using a flat electrode radiator through various signal density/signal combinations, with some signal amplification (-20dB- +60dB), to the skin's surface on the opposite side and extended by the higher range sounds of the signal. The special analogous process makes it possible that the biophysical information content of detected and back-transmitted electro-electromagnetic signal is much larger than in digitized methods (Figure 2).

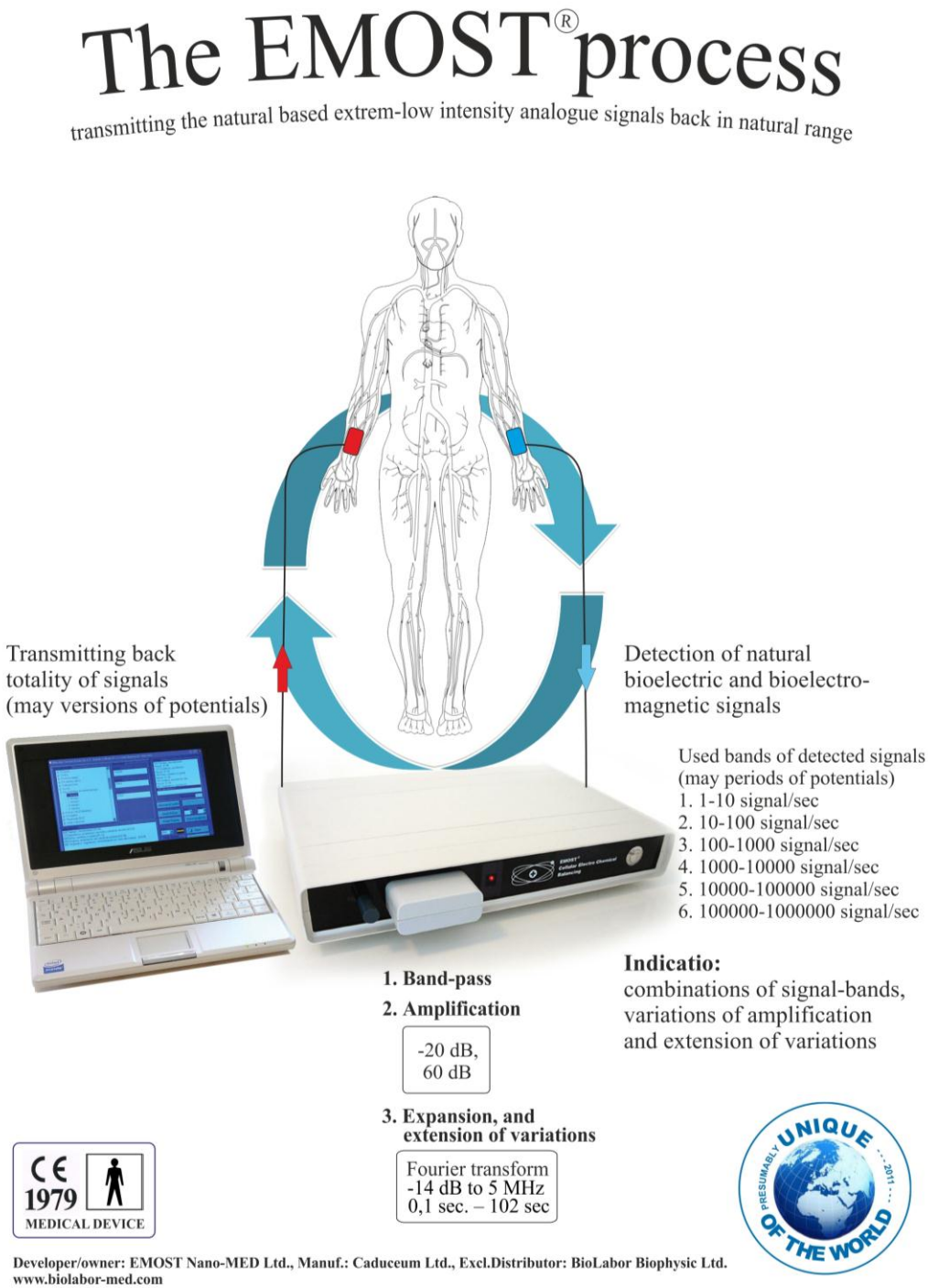

Figure 1. EMOST Redox 1.1. Medical Device (Certificate: HU11/6192) controlled by a personal computer.

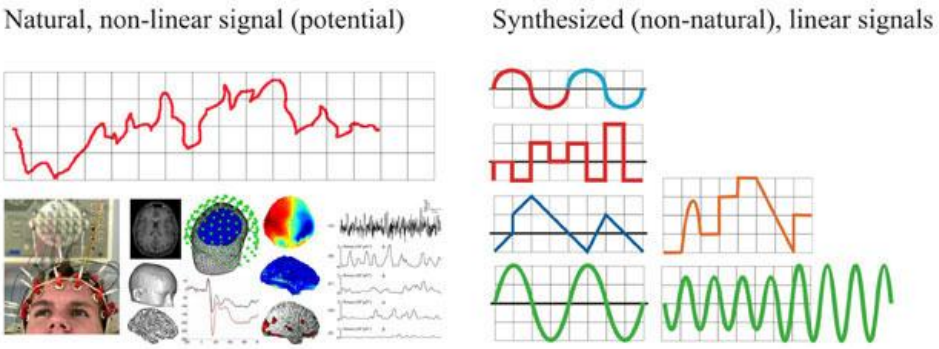

Figure 2. Differences of natural and synthesized (digilatized) signals, or impulses

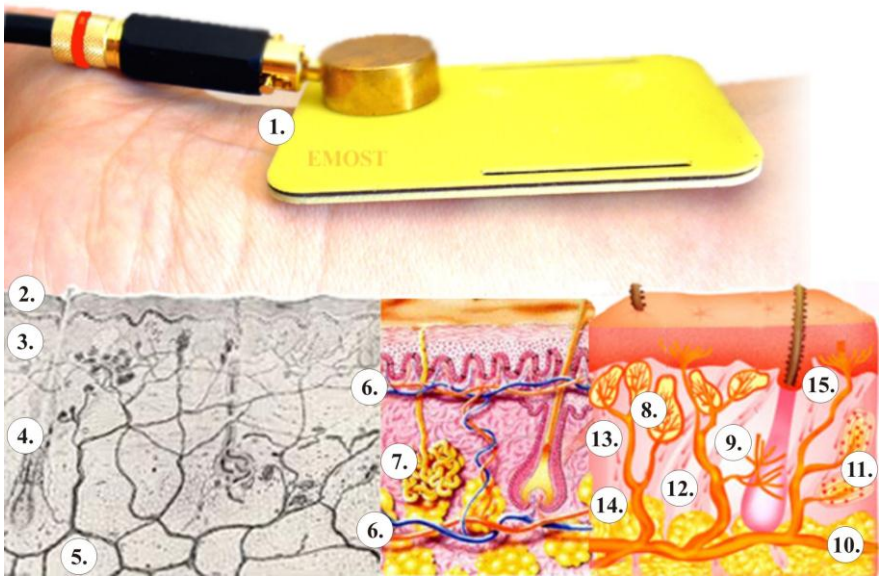

Figure 3. 1. **EMOST-sensor,** 2. skin, 3. epidermis, 4. dermis, 5. fat, 6. blood wessels, 7. sweat gland, 8. receptors, 9. free nerve endings, 10. nerve, 11. Meisner corpusle, 12. neuropeptides, 13. hormones, 14. proteases, 15. cytokines

4. EMOST method exerts its effect through the skin associated autonomous nervous system

EMOST™ device can detect non-linear bioelectric and bioelectromagnetic signals from subjects' skin. The innervated skin is a tremendous complex system and the largest organ of the body with numerous very important functions that is linked to the peripheral sensory nervous system (PNS), the autonomous nervous system (ANS), and the central nervous system (CNS) (Roosterman et al., 2006). There is growing evidence that the cutaneous peripheral nervous system has essential roles in skin homeostasis as well as in diseases. Cutaneous nerves can react to stimuli from the circulation and to emotions. Moreover, the central nervous system is directly (through efferent nerves or CNS-derived mediators) or indirectly (through the adrenal glands or immune cells) linked to skin functions (Figure 4) (Roosterman et al., 2006).

The skin has densest and most complex innervation of all mammalian organs. There is rising evidence that the cutaneous peripheral nervous system has essential roles in skin homeostasis as well as in diseases. Cutaneous nerves can react to stimuli from the circulation and to emotions. Moreover, the central nervous system is directly (through efferent nerves or CNS-derived mediators) or indirectly (through the adrenal glands or immune cells) linked to skin functions (Figure 4) (Roosterman et al., 2006). Recent studies support that basic emotions have emotion-specific ANS activity/signature (Kreibig, 2010; Stephens et al., 2010). In Collet et al. (1997) experiments, basic emotion (happiness, surprise, anger, fear, sadness and disgust) induced specificity autonomic patterns in the skin regarding recorded parameters such as skin conductance, skin potential, skin resistance, skin blood flow, skin temperature and instantaneous respiratory frequency. It suggests that skin can represent stress related conscious and unconscious emotions directly by efferent nerves and mediators from CNS or indirectly by the adrenal glands or immune cells. The represented stress related conscious and unconscious emotions can affect on biochemical, bioelectrical and bioelectromagnetic patterns. There is bidirectional communication between skin cells and the nervous system that has essential roles in homeostatic regulation during physiological and pathophysiological states (Roosterman et al., 2006).

Under LFI-EMF (or EMOST™) expositions, first the skin meets electromagnetic fields that can exert a complex effect on skin mechanisms. These complex effects can spread by special mechanisms by modulation of specific neuropeptides released from cutaneous nerves that act on target cells by paracrine or endocrine pathway. It is well appreciated that complex interactions exist linking sensory and autonomic nerves to the immune and endocrine systems. In addition, the skin itself produces neuromediators and neurotrophic factors that target nerve fibers, thereby modulating inflammation, immune responses during host defense, pain, and pruritus. Recently, Arck et al. (2010) proposed a unifying model about the gut-brain-skin communication axis**.**

According to Vianale (2008) experiments, ELF-EMF can modulate chemokine production and keratinocyte growth by inhibition of the NF-kappaB signalling pathway and thus may inhibit inflammatory processes. In addition, Patruno et al. (2010) reported that ELF-EMF modulate expression of inducible nitric oxide synthase, endothelial nitric oxide synthase as well as cyclooxygenase-2 in the human keratinocyte cells. Recent experiments support that pulsed electromagnetic or low energy and frequency magnetic fields influence the autonomic nervous system (Grote et al., 2007; Kraiukhina et al., 2010).

Nordlind et al. (2008) in their recent paper, titled, *The skin as a mirror of the soul: exploring the possible roles of serotonin*, state that, ".. alterations in the levels of 5-HT in extracellular fluids can alter the maturation, metabolism, migration and mitosis of its target cells, including those in both the brain and the skin. Serotonin (5-HT) is a significant bidirectional mediator between the neuroendocrine system and the skin. Recently, Irmak (2010) proposed that excitable Merkel cells in the skin (Merkel cells' function is still unclear), which are in close contact with sensory nerve endings, may take part in mammalian magnetoreception. The movement of melanosome with the changing electromagnetic field may open ion channels producing a receptor potential that can be transmitted to brain by sensory neurons.

The above mentioned support that the LFI-EMF (or EMOST) exposition can modulate biochemical, bioelectrical, and bioelectromagnetic processes in the skin, and the modulated skin signals can affect the neuroendocrine system and modulate brain activity through ANS.

All together, it is very probable that EMOST™ method exerts its effect through the skin associated autonomous nervous system, which offers a unique therapy for the treatment of neurological disorders.

5. Particular high-efficiency of EMOST treatments

The particular effectiveness of EMOST™ method is possible due to the analogous process of own non-linear signals detected from skin that makes it possible that the biophysical information content of detected and back-transmitted electromagnetic signal is much larger than in digitized methods. In addition, the application of patient's own signals also makes it possible that all treatment can be individualized.

6. EMOST™ method: can reduce the progression and frequency of the diseases, cost - effective, non invasive, no side effects, easy to use, portable method, not polluting the environment

7. Particular high-efficiency areas of EMOST treatments, according to our several year's experiences

Bone fractures, skin wounds, sleep disturbances, pain, depression, panic, chronic fatigue, gastrointestinal and liver diseases, multiple sclerosis, inflammatory diseases, post traumatic syndrome, in diverse children diseases, cardiovascular parameters, sport injures, general rehabilitation

8. EMOST™, prevention and children

Treatment of children with (chronic) diseases is very important because it serves the prevention and reduces cost. However, the effectiveness of EMOST treatments for children is much stronger than in adult subjects. According to our several year's experiences by EMOST, in children, much less treatment is needed for recovery treatments as opposed to adult subjects, as well as the duration of treatment is shorter. It is possible that this special effectiveness of EMOST treatments is due to the large plasticity of the central and the autonomic nervous system in young patients. Thus, our research pays special attention to study EMOST effectiveness in the field of (chronic) childhood diseases.

9. Many neurological and psychiatric disorders are associated with various additional non neurological diseases, in which EMOST treatments can reduce the progression and frequency of these diseases

EMOST treatments also offer a unique therapy for the treatment of non neurological diseases that are associated with neurological disorders. For example, chronic fatigue is a typical symptom of neurological diseases. Many neurogenic and primary muscle disorders are associated with abnormalities of gut motility. Constipation is a frequent complaint among patients with different neurological diseases. Psychological stress is widely believed to play a major role in functional gastrointestinal disorders, especially irritable bowel syndrome. Sleep behaviour disorder symptoms may be the first manifestations of neurodegenerative and psychiatric diseases.

10. Conclusion: EMOST method offer an unique, individualized therapy for the treatment of neurological (brain) and neurological associated disorders, can reduce cost, and can take important roles in the prevention of various diseases.

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