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CRANIAL ELECTROTHERAPY STIMULATION: A CASE STUDY

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In 46 AD, a Roman physician, Scribonius Largus used an electric eel in the treatment of medical disorders like headaches and gout, by having the patient stand on a beach in proximity to the eel (Kirsch, 2002). In Europe, the use of electricity in medical treatments goes back to the 18th Century. For example, the forerunner of the defibrillator was developed in Europe near the end of the 1700s. In the mid-1850s, precursors to transcutaneous electric nerve stimulators (TENS) were being marketed to control pain (Kirsch, 2002). Over the years, the importance of electrotherapy in the treatment of medical diseases has not diminished, although it has been overshadowed today by pharmacological approaches. Medicine's high costs and frequent serious side-effects, however, have prompted an increased focus on alternative approaches to medical treatments that are based solely on a chemical approach to healing.

Cranial Electrotherapy Stimulation (CES) has been used successfully to treat numerous disorders, including depression (Marshall & Izard, 1974; Cox & Heath, 1975), alcoholism (Krupitsky, Burakov, & Karandashova, 1991), cocaine detoxification (Brovar, 1894), marijuana withdrawal (Overcash & Sieventhall, 1989), acute anxiety (Overcash, 1999), and stress, related to cognitive dysfunctions (Smith, 1999). Of particular relevance to the present study, were demonstrations of CES's utility with incarcerated, violent, and mentally retarded inmates (Childs, 2005) and the treatment of pedophiles and

parolees with impulse control issues (Voris, 1995).

The type of CES unit described in this article is an Alpha-Stim SCS (Stress Control System). The system is FDA cleared for the therapeutic treatment of anxiety, depression, and insomnia. It is cost-effective, with only mild side-effects, which occur infrequently and are generally easily remedied. Several studies (with an accumulation of over 5,000 subjects) have been published examining the effectiveness of the Alpha-Stim SCS as a treatment for mental disorders and pain management. For example, a post-marketing analysis of 349 patients using the Alpha-Stim SCS to reduce anxiety found 91% of patients reported reductions in symptoms where symptom relief was equal to or greater than 25% (Kirsch, 2002).

The minimally effective treatment appears to be 100 micro-amps (uA), although the unit is adjustable up to 500 uA. The uA dosage is determined by the patient, using a control dial on the side of the Alpha-Stim SCS unit. The waveform is bipolar asymmetrical rectangular, with a duty cycle of 50% and a zero net current delivered by a nine volt battery. The unit is portable, 10cm by 7.5 cm, and weighs in at only 106 gm, nine volt battery included.

The unit uses ear clips to deliver the amperage. Felt pads are attached to each ear clip prior to using the unit, to avoid subject discomfort. Alcohol wipes are used to clean the ear lobes prior to treatment and, in post-treatment, to cleanse the ear clips of adhesive residue from the felt pads.

Side-effects are minimal and easily

corrected. These include dizziness, mild headaches, nausea, and rashes on ear lobes. Neutralization of these side-effects is generally managed by reducing the uA.

The Alpha-Stim SCS seems to change the electrical and chemical activity of certain nerve cells in the brainstem (and) amplify activity in some neurological systems, and diminish activity in others. This neurological fine tuning is called modulation (Electromedical Products International, 2006). The end result of amplifying activity is an increase in the production of the neurotransmitter serotonin.

Kennerly's research also provided important insights into changes in cortical functioning secondary to an Alpha-Stim SCS treatment. Using qEEG brainmaps, he studied variations in five bandwidths, Gamma, Beta, Alpha, Theta, and Delta during and after treatment. The treatment was one 20-minute Alpha-Stim SCS session. The brainmaps of his 30 subjects uniformly showed elevations in Delta and Gamma bandwidths across the entire cortex. Post-treatment changes included noticeable reductions in the Delta and Theta bandwidths and a significant increase in Alpha activity (Kennerly, 2004). Elevated Alpha is associated with a relaxed, yet focused state of mind, an important therapeutic effect of the Alpha-Stim SCS.

The 19-year-old Caucasian subject was of average weight and height with no physical disabilities. He was asked to volunteer due to his history of aggression and violence, including a physical

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attack on a detention center security officer. In addition, he had failed at two prior attempts to complete the center's substance abuse treatment program. His physical attack on the officer and threat to do harm to the officer's wife led to the second expulsion. During the past 24 months the subject spent all but 3 months in the county detention center. The next step for the chief of the detention center was to have the subject sent to prison to complete his sentence.

The subject had just enrolled in the drug treatment program for the third time when he volunteered for the study. Despite spending the previous 40 days in administrative segregation, his prognosis by treatment staff was mixed to very poor.

The subject's family was composed of biological parents, two step-parents, two sisters and two step-sisters. His ordinal position was third. During his childhood years, he had lived with his mother and his step-father. His mother was an intermittent recovering alcoholic and his step-father had a history of chronic marijuana abuse. The subject's biological father had a history of methamphetamine abuse, including at least one conviction. The subject reported going to Chicago, Illinois, at age 13 years, where he was initiated into a gang. In that same year, he was sentenced to boot camp for gang activity but was kicked out after fighting with other juveniles and going absent without leave (AWOL).

The subject had an extensive history of fighting and head trauma. As a pre-teen and during his teen years, he reported repeated physical fights with his biological

father. He also fought on the streets, especially when drugs were involved. His nose had been broken twice and he stated that he's had more black-eyes than he can count. The subject reported two serious instances of head trauma. The first was at the age of 4 years when a horse kicked him in the head. The injury required 48 stitches to the left eye-brow area. The injured area was near the orbitofrontal cortex, which is involved with controlling emotions. The second injury, also requiring many stitches, occurred at age of 17 years when he was a passenger in a serious automobile accident.

His history of drug use included marijuana, cocaine, pills, opiates, and barbiturates. He began using crack cocaine and methamphetamine at age 17 years. More recently he started taking meth intravenously.

The subject described his childhood as unhappy, painful, and hard to remember, and that he was active, aggressive, irresponsible, rebellious, and stubborn. Problem areas included difficulties getting along with others, including peers and teachers. He experienced frequent nightmares and he had an intense fear of failure. He also reported a long-standing fear of falling with a childhood onset.

His mother, a nurse by profession, was remembered as generally distant and unpleasant but at times affectionate. He described her discipline as fair, lenient, and inconsistent.

His step-father, who raised him, was a union supervisor at a steel plant. The subject viewed him also as distant and unpleasant, as well as rejecting and abusive. His biological father's discipline was seen as strict and the relationship was punctuated, as noted above, with frequent violent physical fights. Despite difficulties in

their relationship, his mother and step-father were remembered as close, happy, and loving toward one another, but reserved toward him. The subject was never married but did have a 14-month-old daughter, who lived in Europe.

Much of the data suggests a diagnosis of Antisocial Personality Disorder. These include early childhood difficulties, gang membership, inability to adapt to school structure and rules, disruption of the nuclear family, poly-substance use on a daily basis, sex seen as neutral, and an extensive history of violent behavior. His current self-assessment included the following descriptors: forgetful, fearful, angry, confused, calm, hyperactive, and happy. Mitigating indicators included expressions of concern for his mother's addiction and a 3-year work history as a plumber, where he reported working over 40 hours a week.

The treatment program was well designed and included 33 modules. The following is a sampling of those modules: alcohol and drug education, cravings and triggers, spirituality, planning for sobriety, sex/drugs and alcohol, reducing stress, negative emotions, the 12 step program, physical wellness, problem solving skills, attitudes and beliefs, family matters, child development and parenting, money management, sexual abuse, and relapse prevention.

Inmates lived in family pods with 8 to 10 other inmates while attending the treatment program. Each pod had an inmate assigned by the chief of the detention center as pod leader. Pod leader responsibilities included leading by example, leading a group three

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helping pod members achieve at their highest level, ensuring pod rules were followed, and writing weekly reports. Information from pod leaders was considered when staff members made their weekly and monthly evaluations.

As noted above, the treatment was CES and the instrument used was the Alpha-Stim SCS. The specific brain mechanisms by which symptom reductions are achieved are not fully understood. However, it is clear that the waveform, described above, does activate neurons at the top of the brainstem which produce serotonin (5-HT) and, at the same time, inhibits the cholinergic (Ach) and noradrenergic (NE) systems (Electromedical Products International, 2006). Given the above information, it is a fair assumption that CES provides a modulating effect on general brain activity. Modulation of cortical and sub-cortical brain functions can allow a subject to better utilize the training and counseling received during treatment.

The subject received 15 treatment sessions. Each session lasted a minimum of 20 minutes, with most lasting 40 minutes. All sessions were completed within a 45-day treatment period. The co-author, a master's level graduate student and trained in the use of the Alpha-Stim SCS, supervised each session. The sessions were carried out in the detention center's recreation room which was cleared of inmates and all but one security staff member. The daily uA treatment utilized was between 300 and 400 uA. The uA level was chosen by the subject.

As noted above, the measures of change were pre- and post-assessments on the 16PF, the subject's anecdotal observations

and structured self-ratings, and weekly/monthly assessments by the treatment staff. The pre- and post-16PF scores are the only measures highlighted here. Contact the authors for additional pre- and post-measure changes.

Pre- and post-treatment 16PF scores are shown in Table 1. Since the Alpha-Stim SCS has a successful research record for reducing anxiety, it was not surprising that positive changes were found in the categories of Tension and Apprehension. However, improvements with other factors were also found.

Taken together, it appears that a strong positive change was found in 7 of 16 factors (**) while positive changes but smaller in magnitude (*), were found in three additional factors. The subject's scores suggested reductions in tension and apprehension and important increases in warmth, spontaneity, liveliness, sensitivity to others, and

affiliativeness with others, as well as, an increased openness to change. While scores on four variables began near the scale's means and reflected small changes, the noted changes were in the desired direction. These scores suggested that the subject moved toward being more self-disciplined, less threat-sensitive, less emotionally labile, and less non-conforming.

Five factors seemed to reflect changes in a negative direction, Dominance, Vigilance, Privatness, Reasoning, and Abstractness. The increase in Dominance and Vigilance may have been influenced by his promotion to pod leader. The Dominance score was initially in a centrist position and moved toward the forceful and assertive side of the scale. The move in his Vigilance score was less dramatic but it did move even further away from the mean toward high Vigilance. Privatness, a measure of the degree to which a person

TABLE 1: 16PF Scores

Factors	Pre-Assess	Post-Assess	Increase/Decrease
Warmth**	02	10	+8 greater warmth
Reasoning	05	08	+3 more abstract
Emotional Stability*	04	05	+1 greater emotional stability
Dominance	06	09	+3 from high to very high
Liveliness**	05	08	+3 more spontaneous than restraint
Rule-Conscious*	05	06	+1 less non-conforming
Social Boldness*	05	06	+1 less threat sensitive
Sensitivity**	03	06	+3 greater sensitivity to others
Vigilance	08	09	+1 high to very high
Abstractness-0	09	09	00 very high
Privateness	08	09	+1 very non-disclosing
Apprehension**	07	05	-2 less apprehensive
Open to Change**	07	10	+3 very open to change
Self-Reliance**	10	08	-2 more affiliative
Perfectionism*	05	06	+1 more self-disciplined
Tension**	09	05	-4 less tense

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to disclose, went from negative to very negative. Finally the subject's Abstraction and Reasoning scores showed a person who was imaginative and idea-oriented rather than practical and solution-oriented. These two factors moved from centrist positions to strongly abstract. Normally, abstract thinking is associated with intelligence and that may be the case here. However, the polarity on the Abstraction scale is "grounded and practical," two traits that would, seemingly, benefit the subject.

During the treatment period, the subject received no disciplinaries and his mean weekly pull-up averaged only 1.8 per week. Disciplinaries were given for major infractions like stealing and physical violence and pull-ups were given for minor infractions like being late for group or talking in the shower zone.

Five moderator variables seemed of particular interest to the researchers: gender, being the only subject of a research project, belief in treatment, substance abuse treatment program, and time in administrative segregation. Any and all could have contributed to the positive changes found in the subject's behavior.

Gender: Time with the co-author, who was female, could have provided a strong motivation to the subject.

Subject of research: The inmate was the only subject singled out in the entire detention center for participation in the research project.

Belief in the treatment: The subject may have experienced a motivation to change due to his belief in the CES treatment rather

than being changed by the actual uA current.

Substance abuse treatment program: The subject was participating in a drug treatment program which offered him new methods for improving himself.

Time in administrative segregation: The subject had completed 40 days in isolation just before reentering the drug treatment program for the third time. Time in isolation frequently brings about changes in an inmate's attitudes and behaviors upon release, sometimes for the better.

By almost all measures, there were positive changes in the subject's behavior beginning with the introduction of the Alpha-Stim SCS treatment. The daily means of his personal self-assessments showed dramatic improvement, including a recovery from two gaps in treatment delivery. The positive changes were noted in both the subject's anecdotal statements and structured assessments.

Results from the 16PF demonstrated notable improvements in 7 of 16 factors. These reflected an individual who was more relaxed, interested in others, and open to change. Weekly staff assessments also supported the above findings, as did the monthly assessments. While disciplinary comparisons could not be made, it was noteworthy that he received no disciplinaries during the treatment period and only 1.8 pull-ups per week.

Shortly after his promotion, the subject resigned as pod leader. The down-side of this decision was his failure to accept the challenges of being a responsible leader. On the up-side, the subject realized that he lacked the necessary leadership skills for the position, noted in four 16PF scales that showed

negative changes. Given his lack of leadership skills, the subject's decision could be seen as positive and proactive. Specifically, his leadership style was based on a dictatorial approach, the only one he was familiar with, and it was preventing him from becoming successful in the new position.

In all probability, some of the moderator variables made a contribution to the subject's success. The two variables most likely to have had an influence, were gender of the co-author who supervised the daily treatment and the subject's belief in the treatment's effectiveness.

The substance abuse treatment program had not brought about positive change in two previous enrollments and the prognosis was unfavorable. However, once there was a brain modulation effect, the subject seemed to benefit from the treatment program's structure, new information, and opportunities to succeed.

Time in administrative segregation seemed to have the positive effect of getting the subject's attention regarding his behavior. That is, he had tested the institutions limits and experienced the result. Following his release from administrative segregation, weekly and monthly evaluations offered support, on one hand, for the belief that the subject was more interested in making changes, but also raised questions about the subject's motivation for change. His commitment to change seemed driven by a strong desire to avoid another 40 days in administrative segregation.

The Alpha-Stim SCS's influence on cortical and sub-cortical function would suggest that increasing the Alpha bandwidth did have

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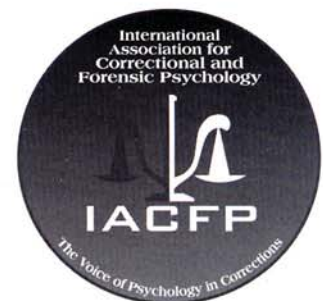
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the anticipated modulating effect which resulted in the subject being more relaxed and able to use the training that he received via the drug treatment program and counseling. It is noteworthy that the subject did graduate from the treatment program at the completion of the third attempt. These results, along with low cost, minimal training for mental health staff, and only minor side-effects, suggest CES as a treatment for non-predatorial aggressive and violent behavior warrant further study.

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**ITEMS OF INTEREST**