



A Study of Writer's Cramp Clinico-Multivariate Statistical Analysis with ARTEMG

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Abstract

In this study we have applied the real-time advanced multi-channel EMG (ARTEMG) for the clinico-statistical inferences through multivariate analysis techniques. The study demonstrated paramount computable 'EMG' variations in the Writer's cramp-signals (WCS) observed whilst writing through both right-hand(RH) and left-hand(LH) amongst those Writer's cramp(WC) diseased subjects (patients) thru concordant mirror movements designated as "C-cohort" contrasted those with discordant mirror movements designated as "D-cohort". This was observed primarily in the measures-of-dispersion/central tendency(MoD/CT) of the signal i.e., standard-dispersion, variances and their ratios/F-ratios which are clinic-statistically dissimilar amid the two cohorts, i.e., C and D, plus the signature-pattern-of-variations were consistently-stable in conjunction with the rationale-hypothesis that the cohort D had a compensatory-exertion (CE) which overwhelmed the dystonic-exertion (DE) outcome in the last irregular-posture significantly. This was observed in the manner in the structure of more variations and basic-changes in RH ascribing signal (RHAS) in D-cohort as equated to C-cohort, as the dystonia and compensatory-exertions both impact to the uncertainty. Hence these changes were vigorous also examined in each degree of diffusion, for instance in the signals signature-patterns of implication of fisher-values for the ratios-of-variances (RoV). These investigates might conceivably be useful to longitudinal developments to well comprehend the concept of dystonic-WCs.

Keywords: Writer's Cramp; Multivariate; Analysis; ARTEMG

Introduction Dystonia

It was in 1911 while the dystonia term was initially castoff by Oppenheim [1] to label a disorder/or syndrome instigating mutable-muscle tone also persistent muscle-spasms [1,2]. The dystonia is at present well-defined as a neurological-syndrome characterized by involuntary, sustained, patterned, and frequently monotonous muscle-cramps of contrasting-muscles, producing meandering movements or irregular uncharacteristic-postures [2].

Antique view of dystonic writer's cramp Widespread dystonia

In the year 1888, Gower demonstrated the dystonia. He has coined the term "tetanoid-chorea" to label the movement-disorder

(MD) in dual relative-siblings, which was later originate to have Wilson's (Willison's) disease [3].

3 years before Oppenheim, Marcus (Walter-Schwalbe) labeled a intimate of 3-relative-siblings through a alike illness, in which he labelled it as chronic-cramp-syndrome (CCS) through hysterical/overexcited and panic stricken-symptoms was measured and well-thought-out it to be a psycho-genic-disorder [4].

In the year 1911, Oppenheim-Hermann [5] and George (Theodor-Ziehen) [6] distributed virtually concurrent intelligences hearsays unfolding the main torsion-dystonia. Hermann was the first scientists to coin-the-terms dysbasialordotica progressive-

dystonia (DLPD)", Musculo-rum-deformans (MRD)", and that aimed at relating its dromedary-gait.

However, the terminology was very much disparaged as changing-mutable muscle-tone was non unavoidably typical of the syndrome, and the term Musculo-rum erroneously oblique disguised that the reflex (involuntary) movement measure was because of a muscle-syndrome, as well as not every patient become distorted. Herz., *et al.* [2-6], by the aid of EMG-signal acquisition-recordings derived the disorder/syndrome as sluggish-continued-postures. Lastly in the year 1984, an impromptu off-the-cuff commission of dystonia-medical research-foundation provided the broadly satisfactory contemporary derivation [2].

Writer's cramp

WC is one of the widespread focal-dystonia's which was labeled 200 years prior to primary-torsion dystonia. In 1713, Ramazzini explained in *De Morbis Artificum*, that a patient was suffering with intense-fatigue in his right hand, so he was imparted training to practice with left hand. However, the left hand was also paralyzed in a month or so [7].

Later it was described by Bell and Bruck in 1831 as scrivener's palsy [8]. Nevertheless till 1930's it was measured to be a psychological-disease, referred to as occupational/work-related-neurosis by the Gower's [9]. In 20th century, a neuro-logical-basis was measured subsequently following Collier [10], as well as Adi-Collier initially recommended irregularities of basal-ganglia (BG) as the fundamental-patho- physiology [10]. Smooth in the following half of 20th-century numerous neurophysiologists, electroneuro-physiologists, neurologists comprising Sir "John-Walton" well-thought-out Writer's Cramp to be of psychogenic source as labelled in the 9th-edition of *Brain's disease of the nervous-system* [11]. WC were initially predictable to segment mutual-features/and feature-manifestations (signs and symptoms) through and was encompassed in the cohort of focal-dystonia's (f-dystonia's) in Marsden [12] and also Sheehy-Marsden [12]. It was supplementarily categorized WC's in to modest plus Dystonic-WC's. Per the start of several indeed innumerable and further classy and urbane/sophisticated "imaging-signal-modalities", the biological-organic nature of Writer's Cramp (WC) is not anymore in dilemma [13-18].

Objectives

The main aim of this study is to determine if there is a quantifiable EMG difference in Writer's Cramp (WC) subjects (patients)

through Concordant-mirror-movements (CMMs) as of those through Discordant-MMs (DMMs). pitching

The secondary-aim was to build an advanced real-time multi-channel EMG-machine to acquire as of 5 muscles concurrently by means of innocuous-fine nylon-coated micro-wires (with 50 micron (μ) diameter) plus vital programmable-software and for the custom built programmes to quantitatively study the disease.

Endpoints

Primary

Difference in EMG signals from the right hand (RH) in writing with either hand between patients with Concordant and Discordant MMs in [19,20]

- Amplitude means
- Amplitude means differences, and their t-values and p-values
- Variances, f-ratios and p-values
- Standard deviations.

Secondary

- Patterns of significance of values for difference in means
- Patterns of significance of f-values for the ratios of variances
- Analysis of variances for means and standard deviations (SDs)
- Singular value decomposition of means and standard deviations (SDs)
- Canonical correlation analysis
- Correlation data analysis computations for individual patients
- Similarity investigations of means (t-values) variances (f-ratios) [20,21].

Methods

Diagnosis

The diagnostics of WCs is in accordance with the background of diagnosis plus manifestation of dystonic writing. Examinations were also not available. Moreover examination in conjunction with nerve-conduction velocity (NCV) with EMG was performed in the direction of assessment for basic and fundamental neuro-pathic for detecting what muscles concerned.

Diagnosis through variances/differential

The arm might be implicated in a variety of more syndromes plus an obvious record together with a comprehensive neurological testing can aid to differentiate it as of many more syndromes.

- Discomfort soreness (ache) in the arm: Carpal-tunnel-syndrome (CTS) derived auxiliary to intermediate nerve-density or firmness and Musculo skeletal issues.

- Main composing write-down-tremor is typically diagnosed erroneously as dystonic-WCs. Which is a huge tremor (with larger fluctuations and oscillations, i.e., amplitudes of AC and DC motor) arising in the course of composing the task of write only. Nevertheless, it is dissociated dystonic-WCs or else discomfort or ache also in the sphere of disparity towards basic critical-or essential-tremor.
- Simplified general and widespread dystonia particularly idiopathic universal dystonia might establish primarily as WCs. Examine to more co-current dystonic-WCs separately as of arm-dystonic WCs that aids during clinical and/or diagnostics examinations.
- Spelling anomalies might be the preliminary or primary feature-manifestations or signs and symptoms, syndromes etc. for examining in subjects including or together with auxiliary dystonic WCs for instance Willison's/disease plus Parkinson tremor disease.
- Repetitive-strain-injury syndrome (or neuromuscular disorder, polymyositis) indicates to numerous and a variety of signs and syndromes arising for the duration of sustained application of various gadgets keyboards (on and off) consequential fashionable agony and discomfort in arm, and also entire-arm-hands [2,8].

EMG in writer's cramp

Electromyography (E.M.G) is routinely used for guiding botulinum injections into muscles once muscle selection is over [21,22]. Use of routine EMG in selecting muscles for injecting botulinum toxin may be of assistance but is limited by the fact that restricted random E.M.G sampling may give limited unrepresentative information. Additionally, electromyographic detections can be thwarted by means of compensatory-movements plus irritation locally triggered through the sensors of electromyographic-electro neuro sensors/wires. To get rid of these problems, micro miniaturized micro electrodes were embedded obsessed by compound-muscles which could acquire muscle-signals/waveforms through the application-of-ENMG throughout the stimulation of dystonic WS-muscles plus give, offer considerable and significant data-analysis-information in the participation of cavernous and profound or else not clearly understandable ECR-ECU and FCR-FCU-muscles. Figure 1 shows the writs-flexor-dystonia as well as flexor mirror dystonia (MD) in a 16year old male patient.

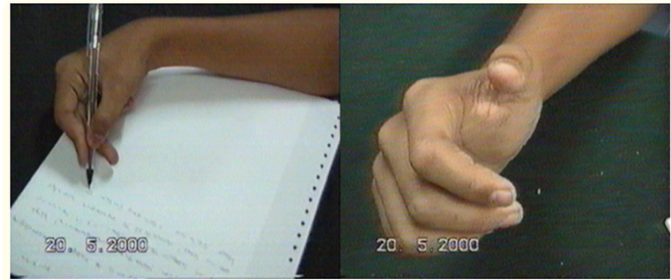


Figure 1: Wrist flexor dystonia (right) as well as concordant flexor mirror dystonia (MD) in a 16-year-old male. Notice that the discordant extensor thumb MD.

Results and Discussion

Patients during their writing scribbling, we noticed the mirror movements (MMs) in the dominant intrinsic hand in WCs subjects this is while ascribing by the other hand i.e., intrinsic but non-dominant hand and these movements might be unique dystonia development during scribbling or ascribing the text/sentence by the R-H (concordant) else participating in the reverse-path (discordant). The major work in this article which is the goal is for discriminating the C and D movements in subjects affected by WCs such that for ascertaining that there is a quantifiable difference between these two groups and to design and fabricate a multi-channel E.M.G system. The experiments were conducted in our indigenously developed model ENMG laboratory which was a part of our doctoral project at the Ms. "Nizam Institute-of-Medical Sciences" a tertiary-care super specialized Telangana state university (Act-1987) hospital and research centre (Aug 1998-2005). A well designed system was developed to acquire the neuro-muscular-signals of the subjects with dystonic-WC's. Innocuous copper-wired flat electrodes (Ag-Silver) were built and a smart EMG system was built, and the electrodes size was 50-100microns.

The signals-data comprised of 23-hand-muscles of RHs followed by LHs (for detecting the mirror-dystonic-dominant prime-muscle). The data gathered during right hand ascribing signal (RHAS) and left-hand ascribing signal (LHAS). Statistical tests such as t , χ^2 (Chi-square), Fishers', etc. Twelve (12) WCs subjects-patients (8 including concordant and 4 including-with discordant-MMs) were assessed. While differentiating the methods-of-dispersion, the cohort-D had statistically paramount noteworthy alteration

and transformation too concerning L.H.A.S followed by R.H.A.S (variation,-SD, followed by F-ratio) beside huge discrepancy in R.H.A.S, as linked to the cohort-C, in which the variations followed by the standard-deviation`s remained equivalent or identical else tiny and thin in R.H.A.S equated to L.H.A.S. The amplitudes averages for the R.H.A.S followed by L.H.A.S for the matching-muscles, however vary meaningfully in terms-of-statistics, displayed a dependable and/or reliable muscle-pattern/signatures into fifth-differing-muscle(each muscle differ while acquiring the 5th-primary-dytonic muscle discovery) through the higher-amplitudes-mean/averages in left hand (in every-patient) therefore was not having any worth for discriminating amid cohorts C and D. The results indicate that nature-of the E. M. G and E. M. G consistency and/or rationality in dystonic-wc`s might conditioned thru stooping motoric-systems, in their structural-(anatomy/anatomical) dissemination plus frequency-properties, appearances and features and individualities among12 [22]. The following Table 1 gives the frequency of the ratio of the variances in fifth dominant muscle, i.e., mirror dystonic muscle.

Group	R ≤ L	R > L	
C	5	3	8
D	0	4	4
	5	7	12

Table 1: Frequency of Ratio-of-Variances in the fifth muscle.

$\chi^2 \cong 4.2857$ for 1 degree-of-freedom (DoF), which is statistically significant at 5% with $p \leq 0.0383$ [19-21].

Conclusions

Our results indicated the most important measurable and computable differentiations of Writers-cram dystonia-subjects dominant and non-dominant hands and arms via cohorts C and D which was visible clearly in the methods-of-dispersions, variances [22].

In the D group larger variances and standard deviations (s.ds.) was observed in the dominant-intrinsic-hand during ascribing as opposed to the non-dominant intrinsic-hand, i.e., left. Whereas the cohort-C variations and SDs was identical and also tinier in intrinsic-righthand differentiated to left.

These differences were robust and seen in every measure of dispersion, such as in the patterns of significance of f-ratios of variances [18-22].

The mean amplitudes for the RHWS and LHWS, which were recorded for the same muscles while writing with either hand, though different in statistical terms in each patient, did not throw much light on the differences between patients and were not helpful in differentiating between the C and D groups.

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