POSTURAL AND AUTONOMIC MODIFICATIONS FOLLOWING OSTEOPATHIC MANIPULATIVE TREATMENT (OMT): COMPARISON BETWEEN TWO TECHNIQUES. A PILOT STUDY

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ABSTRACT

Objective*: With reference to OMT principles consistent mention is made of the capability of stimulating Autonomic Responses through both Ortho- and Para-Sympathetic channels. Several studies have been performed to demonstrate this kind of interaction. The purpose of this pilot study was twofold: 1) Compare different OMTs that supposedly interact either with Ortho- or Para-Sympathetic branches of the Autonomic System; 2) Ascertain whether there is a relationship between Autonomic Balance and Quiet Upright Stance Balance.*

Results*: A Sample of 51 young healthy students underwent to a series of four assessment tests for both functions over a 5 hr period.*

Conclusion*: The time plot of the main parameters afforded by the Heart Rate Variability (HRV) Instrumental Assessment and by the Romberg Test performed on a Force Platform actually confirmed that different OMTs challenge different Autonomic components and can achieve different responses in quiet upright stance balance control.*

Keywords*: static baropodometry, balance, posture, Osteopathic Manipulative Treatment (OMT).*

DOI: 10.19193/0393-6384_2018_2_68

Received *December 30, 2017;* ***Accepted*** *January 20, 2018*

Introduction

The various claims made for Osteopathic Manipulative Treatment (OMT) include the capability of promoting an improvement in autonomic balance[(1)]. The complex interactions between somato-visceral and viscero-somatic reflexes[(2)], the possibility of interfering with the Vegetative Nervous System through manipulation[(3)] and even of a specific role for the Autonomic Nervous System in Osteopathic Therapy[(4)] seem to point towards the scientific development of Osteopathy. It is therefore quite comprehensible that the availability of a technique able to measure SympathoVagal Balance through the spectral analysis of Heart Rate Variability (HRV) induced by the respiratory wave[(5,6)], should be adopted to demonstrate the close relationship between the OMT and such balance. Henley et al. showed as HRV modification in healthy subjects after applying the "cervical myofascial release" (CMR) technique: a significant modification was observed in High Frequency (HF), Low Frequency (LF) Harmonic Power and in their ratio (LF/HF) mainly during the tilt test[(7)]. The modifications were highly significant when compared with those observed in both a Control Group

and a "Sham" OMT one. As suggested by Henley et al. in the conclusion of their paper, our study was primarily aimed to verify whether a technique alternative to the CMR such as the Direct-On-Ground (DOG) could achieve a re-balancing of Sympathovagal control by modifying the LF (Ortho-Sympathetic) component. Another study also indicated a modification of the Parasympathetic HF component after "suboccipital decompression"[8]. A more randomized controlled trail of Italian Authors[9] suggested that OMT can influence Autonomic Nervous System activity increasing parasymphatetic function ad decreasing sympathetic activity, compared to sham therapy and control group. Recent studies[10, 11] showed the influence of manipulation therapy on Autonomic Nervous System function.

Besides the balance of the LF/HF components the aim of this study was understand if:

- Different OMT techniques variously interfered with Autonomic Balance;
- HRV analysis could provide indications suggesting the choice between Ortho- and Para-Sympathetic enhancing technique;
- The chosen OMT technique could promote a significant and specific functional modification;
- The modification after the OMT was either immediate or followed an evolution time pattern before settling.

It was further of interest to determine whether Autonomic Balance modification possibly entailed also a Postural Muscle Tone modification that could be observed during the Romberg Test on a Force Platform.

Furthermore, studying postural control, we are faced with a complex system in that many aspects of neurosensory are still to be completely clarified, such as relations with oculomotor, audiological, respiratory and swallowing functions[12-15]. As far as neuro-muscular tone is concerned, there is a trade-off between Stability and Mobility requirements which is closely related to spontaneous falls in older adults[16-21]. A further stimulus to focus our interest on OMT and balance comes from several papers stating that OMT could be beneficial for improving balance and reducing the Risk-Of-Fall (ROF) in the senior population[22, 23].

Materials and methods

The Sample

51 healthy volunteers were randomly assigned to three groups: A (OMT DOG; 13F + 9M - Age 28-40); B (OMT 4-CV (9F + 12M - Age 24-36); C (CONTROL 4F + 4M - Age 25-30). The healthy volunteers, duly informed and having expressed their written consent, were devoid of any known pathology or dysfunction. To minimize any interference with neurovegetative balance, all tests were performed with empty bladder and at least 2 hrs after food ingestion. All subjects were non-smokers and had not engaged in any sports activity before the test.

The OMT

- DOG treatment consisted of a thrust over the dorsal tract of the column (High Speed - Low Amplitude);
- 4-CV treatment consisted of a slight compression of occipital squama lasting around 10 minutes.

Stimulation-wise the treatments were considered equivalent and were administered by the same medical practitioner to ensure minimal intragroup variability.

The Instrumental tests

Timing

The 51 volunteers were tested 4 times (T_0, T_2, T^3, T_4,) as follows:

T_0	Baseline
T_1	time of the OMT, within 5 min from T_0
T_2	T_0+20 min
T_3	T_0+100 min
T_4	T0+280 min

Heart Rate Variability (HRV)

HRV was measured using the SA3000P device (Medicore - Kr) through photoplethismographic probe over the second fingertip of the left hand. The volunteer sat in a quiet room for 5 minutes prior to starting the recording. The recording lasted 5 minutes as recommended by the standards of HRV calculation[5].

Balance Tests

The Romberg test was performed on the ARGO Force Platform (RGMD - Italy) according to the criteria laid down for this kind of test[24-28]. Two recordings (Closed and Open Eyes) were performed in each test. Each recording lasted 45 seconds (the data of the first 5 seconds were not taken

into account because considered as adaptation phase). Subjects stood with their arms hanging loose at their side. The head was up, the mouth closed with un-clenched teeth.

Data Processing

All recorded data were processed in "blind" mode.

Heart Rate Variability (HRV)

Data were broken down by group and time. The following parameters were analyzed[29]:

- Normalized HF (parasympathetic) (0.15<f<0.4 Hz)
- Normalized LF (orthosympathetic) (0.04<f<0.15 Hz)
- Ratio between normalized LF and HF values
- Total VLF power (f≤0.04 Hz)
- Total Harmonic Power
- SDNN (Standard Deviation of the Normal-to-Normal RR.

Data were normalized to the T0 value using the formula VTx = 100 x VTx/VT0

Data were then plotted vs. time.

Balance Tests

All the device produced parameters were recorded and the following were analyzed:

- Sway Path, or the length of the COP path;
- Sway Area, or the area swept by the radius connecting the mean Center Of Pressure (COP) with all the subsequent instantaneous COP measured by the force platform during the test;
- 95% Confidence Ellipse Area, or the smallest ellipse containing 95% of the COP path;
- The Mean Stay Time over the instantaneous Centers Of Stabilization (COS) afforded by the COP path, as described in the "Sway Density" concept[30-31];
- The Mean Spatial Distance between subsequent COSs, defined as above.

The Sway Parameters (Sway Path and Sway Area) were normalized to the acquisition time because there is still no consensus on the test time[25].

Data were normalized to the T_0 value using the formula $VT_x = 100 \times VT_x/VT_0$

Data were then plotted vs. time.

Additional parameters were calculated in an effort to provide indications of greater clinical significance.

a) The Ratio between the Sway Area and the Sway Path, as an expression of the postural tonus. Assuming a circular Path, SA is actually the area of the circle [or $\pi \times r^2$] while the SP is the circumference of the circle itself [or $2 \times \pi \times r$] and their ratio is therefore clearly proportional to the Mean Sway Radius (SA/SP = ½ r). The Normal value for this indicator is around 2 (Closed Eyes Mean value 2.25; Open Eyes Mean Value 1.63).

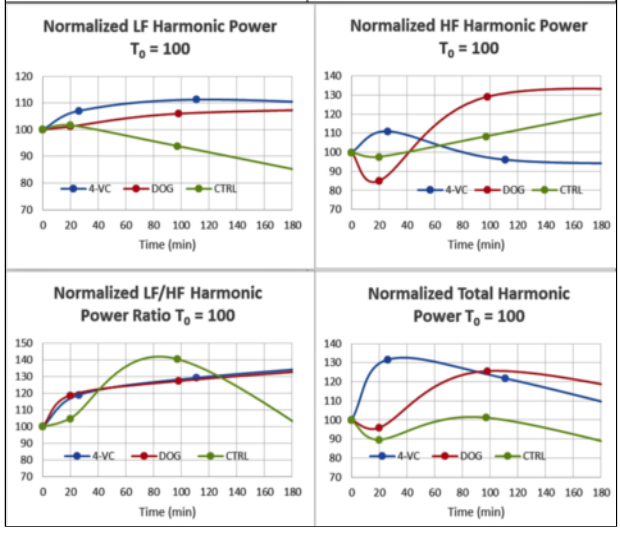
b) The Ratio between the Mean Spatial Distance and the Mean Stay Time Parameters of the Sway Density Plot. While the Mean Stay Time is roughly proportional to the absence of de-stabilizing (or un-balancing) factors, the Mean Spatial Distance between subsequent COSs is roughly proportional to the capability of regaining balance. The Ratio should tend to zero and the Normal value for this indicator is around 5 (Closed Eyes Mean value 9.13; Open Eyes Mean Value 2.64).

Results

OMT seems clearly capable of affecting both Sympathovagal functions and balance in upright quiet standing. The two OMT Groups actually show a different response, both in the Ortho vs Para Sympathetic functional performances and in the upright quiet standing balance performance, in respect of the Control Group which, on the contrary, shows a considerable steadiness in the observed parameters.

Heart Rate Variability (HRV)

Table 1 – HRV RESULTS



Observation of Table 1 Graphs suggests that:

- DOG treated subjects show an immediate

depression of the Ortho-Sympathetic component of HRV and a contemporary increase of the Para-Sympathetic component;

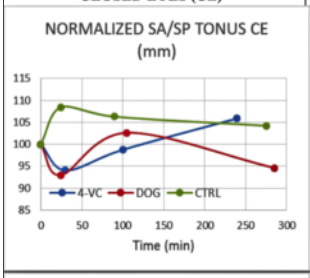
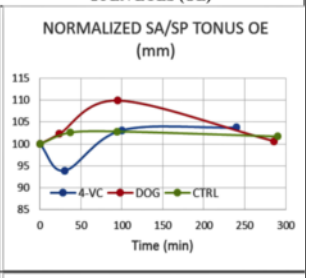
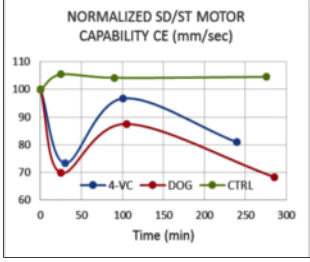
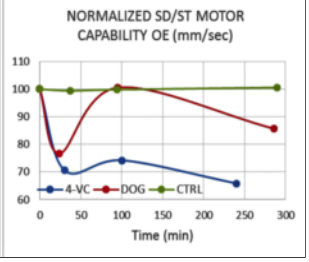
• 4-CV effect is delayed and acts in the opposite direction to DOG: the Ortho-Sympathetic component is increased whilst the Para-Sympathetic one is depressed. This result is fully consistent with indications emerging from previous studies[32];

• 4-CV effect is beneficial to the overall functionality of the Autonomic System as shown by the substantially increased Total Harmonic Power.

Balance Tests

Observation of Table 2 Graphs suggests that:

Table 2 – BALANCE TESTS RESULTS

CLOSED EYES (CE)	OPEN EYES (OE)
	
	

• OMTs have an effect on Balance control: the relatively small fluctuations in the plot of the parameters from the Control Group underline the fact;

• Both OMTs affect the postural tone by immediately increasing its value (reduction of the Sway Radius demonstrated by the reduction of the SA/SP ratio);

• Whilst 4-CV shows a tendency to reduce the tonus after the transition phase (SA/SP increase), DOG seems to show a clear tendency towards a Hypertonic Compensation (SA/SP reduction);

• The SD/ST parameter should ideally tend to zero: the Closed Eyes plot shows the beneficial effect of both OMTs;

• There is a considerable difference between the modifications of the SD/ST parameters observed in the Open Eyes Tests. Whilst the 4-CV shows a greater benefit and retains its beneficial effect, the DOG, on the contrary, shows only a temporary effect.

As the only difference between the two tests is the Closed or Open Eyes condition and as the effect is significantly greater in the Open Eyes condition, a specific beneficial effect of 4-CV over the sensory integration of the visual information could be hypothesized.

Discussion

The results of the tests performed on 51 healthy young subjects show that:

a) both OMTs affect the Autonomic System by promoting significant modifications;

b) both Autonomic Tone and Postural Tone are affected, suggesting the possible application of these OMTs both for Systemic re-balancing and to ameliorate balance control;

c) a key for selecting one of the two techniques may lie in the specific capability of DOG to enhance the Para-Sympathetic component, whilst 4-CV appears to enhance the Ortho-Sympathetic component;

d) a preliminary HRV assessment might help the Osteopath select the most appropriate therapeutic approach.

The Data are however rather “noisy” as they are most likely affected by the wide variability of the factors - both physiological and psychological - that can modify the Autonomic System.

It is therefore our opinion that this Pilot Study should lead to a more comprehensive multi-centric test with several major upgradings to be performed as shown graphically in Table 3:

• All the healthy subjects should be HRV and Balance tested prior to the test. Exclusion criteria should include the performance in one or both tests outside the Normal Range.

• Smokers, Subjects assuming medication drugs, Excellence Athletes should be excluded.

• Participants should be instructed to maintain a steady and healthy lifestyle for at least two days before test.

• Based on the preliminary HRV screening, participants should be subdivided into two major populations of Ortho - or Para-Sympathetic prevalence subjects. From each population two Groups should be formed, to be treated respectively by DOG or 4-CV. Besides the Four Groups, a balanced quota of Ortho and Para Subjects should form the Control Group.

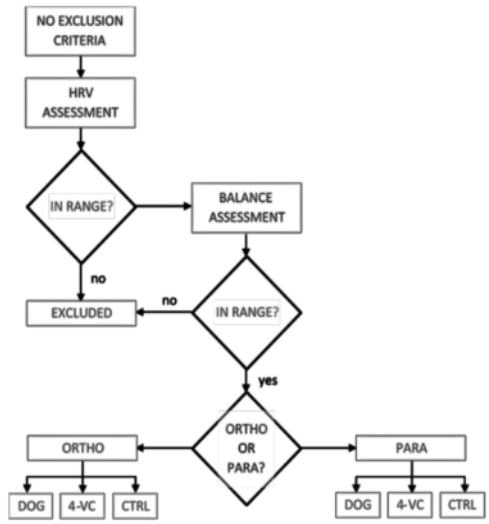
• At least two Groups of pathological subjects, ideally age-matched, should be enlisted: one with

Ortho and one with Para-Sympathetic Prevalence.

• ests should be performed from 8 am to 12 noon. No activities likely to affect the Autonomic Functions should be allowed within the test period and all the subjects should behave in the same way.

• Based on the findings of the 4-CV's assumed capability to have a direct effect on visual input integration, a specific test of visual performance should also be included.

Table 3 – Full Test – Group Assignment Process



As stated, the two techniques selectively affect the Autonomic System and can both be used to ameliorate postural balance. These results could prove extremely helpful in routine Osteopathic treatment. The Authors firmly believe that a more thorough multi-centric study could provide a strong Evidence Based Indication capable of significantly improving both the clinical application and the understanding of the physiology of the complex, multi-faceted mechanisms of Osteopathic Treatment.

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Acknowledgments:
The authors wish to express their warmest thanks to Fabio Delfini, DO, Alessandra Evangelista, DO, Alberto Ferrante, MD, Fabrizio Magnifica, DO and Fabrizio Sabellico, DO for the extremely valuable and professional assistance they provided in the performance of the study.

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