Are There Electrical Devices that can Measure the body's Energy State Change to an Acupuncture Treatment? Part II, The Gas Discharge Visualization (GDV) Device

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Introduction

The general field of energy medicine is growing strongly but is still in great need of reliable monitoring instruments to assess the relative energetic state of humans with respect to a healthy/pathology ratio. According to ancient Chinese medical therapy, the overall energy state and health condition of a human is largely determined by the flow of a substance called Qi through a system of channels, called meridians, distributed throughout the human body. Qi, is thought to flow into and out of the body via a network of acupuncture points and via the meridian network, to nourish various organ systems, neural systems, muscle groups, etc., of the coarse physical body[1]. Imbalances between Qi flow in the various meridians is thought to over-nourish various coarse physical body systems and under-nourish others, leading eventually to different types of pathology development in such systems. Stimulation of specific acupuncture points via one of a variety of procedures, is thought to perturb the Qi-flow pattern towards optimal balance for the body and create a lessening or removal of the growing pathology. The NIH consensus report states that acupuncture has been quite helpful for lessening the severity of a variety of human disorders [2]. It is therefore quite natural that commercial devices for evaluating the condition of the meridian energy state would be seriously considered by those involved in complementary and alternative medicine.

We recently selected two commercial instruments for an in-parallel study of the following question "Can they meaningfully discriminate the effects of acupuncture treatment on the body's energy state?" In this paper, we report on experimental results using, we report on experimental results using Korotkov's Gas Discharge Visualization (GDV) Device, a sophisticated modern-day version of Kirlian photography[3] .

In this exploratory study, 33 randomly-chosen, clinically healthy subjects were utilized in a fashion such as to act as their own control. Data from each device was gathered before and after double-blind needling at both true and sham acupuncture points. The study required two visits by each subject for needling at five different acupuncture points, one for true and one for sham needling. The single research hypothesis was "If energy is added to and/or redistributed in the body via true acupuncture needling, as contrasted with sham acupuncture needling, a worthy measurement instrument must (at least) be able to discriminate this energy change contrast in a statistically significant fashion." Indeed, the GDV instrument passed this test with flying colors and provided much useful adjunct information as well.

Experimental Procedures

A. The Device: The GDV device is thought to work by interacting with the bio-energy field that surrounds the body and captures an aspect of it on video for diagnostic evaluation. The light from electrical coronal discharge patterns are measured at each of the ten fingers, which act as electrical termination points for the 12 main meridians of the body. These coronal discharges are thought to be a result of the human bio-energy field interacting with

the electrical field of the GDV device. At the time of measurement, the emitted light from the interaction is captured by a video camera, and then the images are analyzed with a sophisticated mathematical tool known as fractal dimensionality. The electrical coronal discharge process, being stochastic in nature, lends itself to statistical fractal analysis, therefore providing both quantitative and qualitative diagnostic information never before available in such a non-invasive way. The GDV working parameters are the following: high-voltage impulses of amplitude +10-20 kV, impulse average period of 10 microseconds, frequency of repetition 1024 Hz, total exposure times of 0.5/ 1.0/ 2.0/ 32 sec, parameters average accuracy 1%, average supply current 300 mA, impulse current 3 A, power supply 220V 50/60 Hz or 120V 50/60hz. There is a suite of software accompanying the GDV equipment that analyzes the coronal images providing mathematical integers and coefficients that describe the energy level present in the associated meridians. The GDV diagram program results will be discussed in this paper Fig1.

   B. The Human Protocol: The study required two visits, ~ 3 days apart, to the Shealy clinic. During one visit, subjects received "authentic" acupuncture and, during the second visit, they would receive "sham" acupuncture, both being administered by one us (CNS).   At random, 18 of the subjects were chosen to receive authentic acupuncture during the first session, while the other 16 received sham acupuncture and vice versa for the second session. Five acupuncture points were selected for needling: LI-4, right and left (Large intestine), LR-3, right and left (Liver) and GV-20 (The Governor Vessel). The needles were left in place for 15 minutes.

   C. Each subject was comfortably seated in a recliner chair within a room of comfortable temperature (~72 °F). After approximately 5 minutes of acclimation to the room, the subject's temperature and heart rate were recorded by a nurse. At the start of each day the GDV was used for patient measurements, a set of calibration images were taken to ascertain the stability of the GDV device. Each of the patients were asked to stand in front of the GDV device while a brief description of the measurement process was explained to them. This involved describing the placement of the hand through the light restricting sheath, and then the placement of each of the ten fingers onto the dielectric plate. Each of the ten fingers was measured, always starting with the right hand, thumb first, followed by the remaining fingers on that hand. The left hand was then measured in the same manner. These measurements were repeated three times in succession. If at any time the image captured by the GDV was not complete, the measurement was repeated for that finger until an accurate image was obtained. An accurate image consisted of proper positioning on the plate, so that the camera within the GDV captured the complete image, and the image consisted of the proper angle and pressure on the dielectric plate.

These measurements consisted of 5 total measurements of all ten fingers for both the authentic and the sham points on each subject. Baseline readings were repeated three times to assess the reproducibility of the measurements acquired by this equipment. All GDV measurements were made by (NRR).
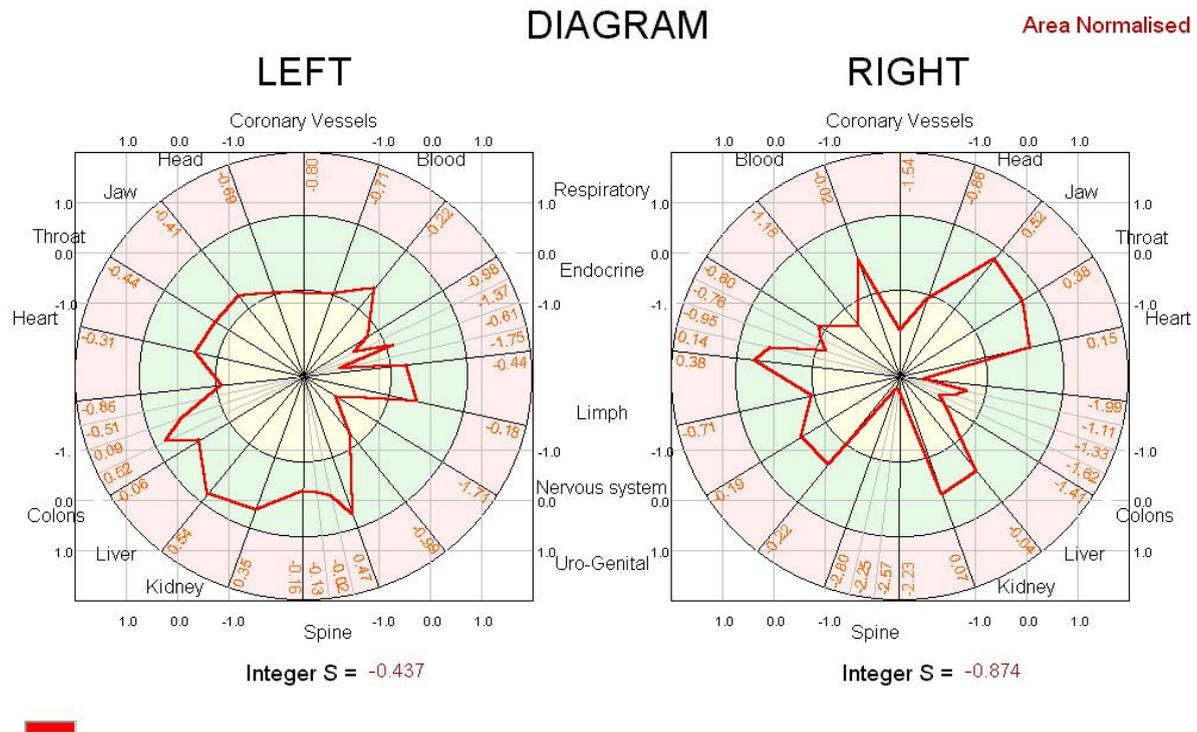
Figure 1 A sample printout from the GDV Diagram program.

Once the baseline measurements were taken, the subjects reclined in the chair and the acupuncturist (CNS) emplaced the five needles. Only CNS and his nurse knew whether the needle placement was authentic or sham. The needles were left in place for 15 minutes and then removed. At 5 minutes and 30 minutes after needle removal, repeat GDV measurements were made. The subjects returned approximately three days later at approximately the same time of day to repeat the measurement process for the second type of needling.

The measurements associated with authentic acupuncture are compared with those from the sham acupuncture needling in the next section. The statistical significance was assessed via both the one-sample t-test and the paired t-test. The sham acupuncture treatment was compared to the three pre-treatment measurements to evaluate possible placebo effects, while these three pre-treatment measurements were utilized to evaluate reproducibility of the individual measurements.

RESULTS

There were 34 subjects measured on two occasions in this study, all 10 fingers were measured three times pre- acupuncture and once at 5 minutes and 30 minutes post needle removal. Thus, the raw database includes a total of 100 measurements for each subject. One of the baseline sets of readings for all 10 fingers measured is presented in Figure 1 as an illustration.

In this study we used the Diagram program and the Processor program for evaluation purposes. From the Diagram program we used the S-integer from the left and right hands. We evaluated the reproducibility of the pre-measurements, and then looked at the S-integer from before the acupuncture to the S-integer after the acupuncture. We then performed the

Paired-t test to evaluate the statistical value of the response of the system from each of the sessions. The S-integer from the left and right sides were compared between pre-acupuncture and post-acupuncture, at both 5 minutes and 30 minutes post needle removal. According to Dr. Korotkov, the left hand represents the mental aspects of the individual, and the right hand represents the physical aspects of the individual.

From the processor program we did the same comparison of pre to post 5-minute and 30-minute for all six parameters mentioned above. For all quantitative values provided by the GDV, we sought to determine whether the system was able to discriminate between the authentic acupuncture session and the sham acupuncture session. The results of the processor program will be presented in a part III continuation paper.

The same expectation existed for the GDV data as with the MSA-21, i.e. it was expected that the shift in energy (as measured by the GDV) between the baseline measurements and the post (needle removal) measurements would be greater as a result of the authentic acupuncture than that for the sham acupuncture. Therefore, if the baseline readings are compared to the post 5 and 30-minute readings, it is expected that a greater shift in energy (difference in the means for the before and after samples) will be seen for the authentic acupuncture readings, than will be seen with the sham acupuncture measurements. Stated another way, we expected that, for the sham, the baseline average $\cong$ post 5 minutes average, and the baseline average $\cong$ post 30 minutes average would result in no energy exchange because needles were placed in non-acupuncture points. But, for the authentic needle application, we should see an energy shift; therefore the baseline averages $\neq$ post 5-minute average and the baseline averages $\neq$ post 30-minute average because the needles were placed in actual acupuncture points.

The GDV software contains a suite of programs as previously described. The Diagram Program calculates the S-integer. The S-integer is given for the average of the three pre measurements and then the Post 5 and 30 minutes for both the right and left hands. Presented in Tables 1 & 2 are the values for the authentic sessions and the corresponding statistics, respectively. The statistical test chosen to evaluate the results of this portion of the experiment is the Paired Difference t-test. This t-test compares one set of measurements with a second set from the same sample. It is often used to compare "before" and "after" scores in experiments to determine whether significant change has occurred. This test is part of Microsoft Windows$_{TM}$ Excel software, and was used for the statistical analysis provided in Tables 2 & 4.

Table 1

S-integer GDV values for pre- and post – authentic acupuncture sessions on both left and right hands

SUBJID	Left Authentic S-integer			Right Authentic S-integer		
	Left pre-avg	L post 5	L Post 30	Right pre-avg	R post 5	R post 30
7a	-0.643	-0.670	-0.684	-0.600	-0.525	-0.491
30a	-0.550	-0.354	-0.544	-0.664	-0.369	-0.619
14a	-0.205	-0.083	-0.119	-0.310	-0.123	-0.335
24a	-0.369	-0.354	-0.501	-0.316	-0.417	-0.311
25a	-0.503	-0.739	-0.508	-0.549	-0.684	-0.368
23b	-0.536	-0.297	-0.199	-0.575	-0.331	-0.331
27b	-0.291	-0.234	-0.349	-0.441	-0.262	-0.076
28b	-0.339	-0.691	-0.705	-0.567	-0.507	-0.587
4b	-0.231	-0.295	-0.048	-0.635	-0.503	-0.162
5b	-0.682	-0.678	-0.614	-0.818	-0.483	-0.694
6b	-0.728	-0.626	-0.680	-0.786	-0.808	-0.704
11a	-0.517	-0.521	-0.632	-0.615	-1.064	-0.617
33a	-0.350	-0.262	0.088	-0.140	0.168	-0.135
32a	-0.780	-0.967	-0.689	-1.062	-0.844	-0.946
20b	-1.455	-1.083	-0.802	-1.684	-1.006	-0.988
8a	-0.512	-0.378	-0.624	-0.618	-0.147	-0.227
21a	-0.369	-0.271	-0.345	-0.601	-0.330	-0.414
29b	-0.753	-0.781	-1.193	-0.955	-0.796	-1.152
22b	-0.173	-0.231	-0.333	-0.236	-0.270	-0.468
3b	-0.743	-1.003	-0.914	-0.609	-0.719	-0.684
10b	-0.416	-0.661	-0.424	-0.283	-0.028	-0.364
16b	-0.460	-0.421	-0.487	-0.696	-0.395	-0.482
9b	-0.560	-0.761	-0.911	-0.766	-1.111	-0.688
26a	-0.448	-0.406	-0.401	-0.392	-0.244	-0.408
31a	-0.372	-0.270	-0.146	-0.536	-0.218	-0.146
12b	-1.206	-1.004	-0.865	-1.340	-0.938	-0.628
13a	-0.471	-0.491	-0.719	-0.332	-0.445	-0.493
15b	-0.729	-0.567	-0.345	-0.728	-0.542	-0.402
1b	-0.464	-0.602	-0.699	-0.624	-0.543	-0.565
2a	-0.316	-0.339	-0.256	-0.689	-0.419	-0.251
18b	0.097	-0.067	0.343	-0.160	-0.021	-0.239
19a	0.012	-0.028	-0.134	-0.242	-0.259	-0.217
34a	-0.276	-0.285	-0.266	-0.210	-0.561	-0.558

Table 2
Statistical analysis for Table 1

Left side Authentic 5 minutes		
t-Test: Paired Two Sample for Means		
	GM-Lpre ave	GLPo5
Mean	-0.4950	-0.4976
Variance	0.0907	0.0794
Observations	33.0000	33.0000
Pearson Correlation	0.8515	
Hypothesized Mean Difference	0.0000	
Df	32.0000	
t Stat	0.0914	
P(T<=t) one-tail	0.4639	
t Critical one-tail	1.6939	
P(T<=t) two-tail	0.9277	
t Critical two-tail	2.0369	

Left side Authentic 30 minutes		
t-Test: Paired Two Sample for Means		
	GM-Lpre ave	GLPo30
Mean	-0.4950	-0.4759
Variance	0.0907	0.1028
Observations	33.0000	33.0000
Pearson Correlation	0.7026	
Hypothesized Mean Difference	0.0000	
df	32.0000	
t Stat	-0.4568	
P(T<=t) one-tail	0.3255	
t Critical one-tail	1.6939	
P(T<=t) two-tail	0.6509	
t Critical two-tail	2.0369	

Right side Authentic 5 minutes		
t-Test: Paired Two Sample for Means		
	GM-Rpre	GRPo5
Mean	-0.5994	-0.4771
Variance	0.1076	0.0967
Observations	33.0000	33.0000
Pearson Correlation	0.7172	
Hypothesized Mean Difference	0.0000	
Df	32.0000	
t Stat	-2.9174	
P(T<=t) one-tail	0.0032	
t Critical one-tail	1.6939	
P(T<=t) two-tail	0.0064	
t Critical two-tail	2.0369	

Right side Authentic 30 minutes		
t-Test: Paired Two Sample for Means		
	GM-Rpre	GRPo30
Mean	-0.5994	-0.4773
Variance	0.1076	0.0639
Observations	33.0000	33.0000
Pearson Correlation	0.6666	
Hypothesized Mean Difference	0.0000	
df	32.0000	
t Stat	-2.8407	
P(T<=t) one-tail	0.0039	
t Critical one-tail	1.6939	
P(T<=t) two-tail	0.0078	
t Critical two-tail	2.0369	

As seen in Table 2, the statistical results for the S-integer as a result of the authentic acupuncture measurements are quite remarkable in that there was a total statistically significant response for the right side and absolutely no statistically significant response for the left side. The data for the sham measurements is given in Table 3 and followed by the statistical results in Table 4. Here again the left side shows no significant result, and neither does the right. The right side at 30 minutes gets close with a p = 0.054 for the one tail t-test.

The complete asymmetry in response as measured by the S-integer value was unexpected. The data was presented to Dr. Korotkov, and his postulate to explain such a result is "the right hand represents the physical aspects of the body, while the left hand represents the mental aspects." Therefore the test results as in Table 2 were as he anticipated

because we had interacted physically with the subjects and therefore would expect to see a right-handed dominance in the results.

It is remarkable, in this author's opinion, the degree to which the right side S-integer responded compared to an almost total absence of statistical response on the left side. The right side responded with p values of 0.0032, and 0.0039 for the 5 and 30-minute measurements, respectively, for the one tail t-test, and p values of 0.006 at 5 minutes and 0.0078 at 30 minutes for the two tail test. As noted, there was an almost total absence of statistical response on the left side. Additional testing would be required to evaluate why this is so.

Table 3

S-integer GDV values for pre- and post – sham acupuncture sessions on both left and right hands

SUBJID	Left Sham S-integer			Right Sham S-integer		
	Left pre-avg	L post 5	L Post 30	Right pre-avg	R post 5	R post 30
7a	-0.347	-0.408	-0.682	-0.338	-0.507	-1.104
30a	-0.575	-0.382	-0.370	-0.600	-0.534	-0.468
14a	-0.226	-0.365	-0.224	-0.176	-0.293	-0.099
24a	-0.312	-0.136	-0.247	-0.196	0.048	-0.090
25a	-0.322	-0.238	-0.084	-0.376	-0.178	-0.101
23b	-0.469	-0.422	-0.754	-0.557	-0.528	-0.847
27b	-0.436	-0.261	-0.191	-0.631	-0.254	-0.193
28b	-0.740	-0.590	-0.411	-0.755	-0.368	-0.605
4b	-0.759	-0.887	-0.548	-0.615	-0.867	-0.383
5b	-0.663	-0.605	-0.518	-0.849	-0.618	-0.567
6b	-0.561	-0.908	-0.674	-0.631	-0.534	-0.964
11a	-0.905	-0.947	-1.072	-1.342	-1.652	-1.371
33a	0.134	0.140	0.106	-0.124	-0.054	0.078
32a	-0.883	-1.083	-0.950	-0.859	-1.442	-1.201
20b	-1.369	-0.945	-0.657	-1.709	-0.749	-0.735
8a	-0.851	-0.489	-0.630	-0.927	-0.568	-0.855
21a	-0.354	-0.158	-0.236	-0.447	-0.350	-0.434
29b	-0.846	-0.358	-0.528	-0.600	-0.333	-0.494
22b	-0.126	-0.179	-0.351	-0.284	-0.284	-0.326
3b	-0.731	-0.650	-0.719	-0.589	-0.679	-0.581
10b	-0.523	-0.262	-0.186	-0.423	-0.254	-0.294
16b	-0.641	-0.561	-0.528	-0.820	-0.730	-0.567
9b	-0.172	-0.256	-0.166	-0.307	-0.144	-0.226
26a	-0.681	-0.338	-0.535	-0.765	-0.830	-0.232
31a	-0.165	-0.092	-0.091	-0.134	-0.032	-0.044
12b	-1.158	-0.848	-0.851	-1.102	-0.773	-0.626
13a	-1.003	-0.826	-0.826	-0.939	-0.790	-0.480
15b	-0.450	-0.225	-0.374	-0.561	-0.299	-0.367
1b	-0.610	-0.861	-0.818	-0.628	-0.514	-0.905
2a	-0.487	-1.459	-1.153	-0.525	-1.358	-1.107
18b	0.312	0.465	0.270	0.091	-0.286	0.055
19a	-0.148	0.057	0.056	-0.477	-0.080	-0.143

| 34a | -0.057 | -0.107 | -0.100 | -0.169 | 0.022 | 0.062 |

Table 4
Statistical analysis for Table 3

Left side Sham			Left side Sham		
t-Test: Paired Two Sample for Means			t-Test: Paired Two Sample for Means		
	GM-Lpre ave	*GLPo5*		*GM-Lpre ave*	*GLPo30*
Mean	-0.5189	-0.4601	Mean	-0.5189	-0.4558
Variance	0.1312	0.1581	Variance	0.1312	0.1185
Observations	33.0000	33.0000	Observations	33.0000	33.0000
Pearson Correlation	0.7573		Pearson Correlation	0.7528	
Hypothesized Mean Difference	0.0000		Hypothesized Mean Difference	0.0000	
Df	32.0000		df	32.0000	
t Stat	-1.2667		t Stat	-1.4565	
P(T<=t) one-tail	0.1072		P(T<=t) one-tail	0.0775	
t Critical one-tail	1.6939		t Critical one-tail	1.6939	
P(T<=t) two-tail	0.2144		P(T<=t) two-tail	0.1550	
t Critical two-tail	2.0369		t Critical two-tail	2.0369	
Right side Sham			**Right side Sham**		
t-Test: Paired Two Sample for Means			t-Test: Paired Two Sample for Means		
	GM-Rpre	*GRPo5*		*GM-Rpre*	*GRPo30*
Mean	-0.5867	-0.5095	Mean	-0.5867	-0.4913
Variance	0.1348	0.1650	Variance	0.1348	0.1511
Observations	33.0000	33.0000	Observations	33.0000	33.0000
Pearson Correlation	0.6628		Pearson Correlation	0.6184	
Hypothesized Mean Difference	0.0000		Hypothesized Mean Difference	0.0000	
Df	32.0000		df	32.0000	
t Stat	-1.3892		t Stat	-1.6569	
P(T<=t) one-tail	0.0872		P(T<=t) one-tail	0.0537	
t Critical one-tail	1.6939		t Critical one-tail	1.6939	
P(T<=t) two-tail	0.1744		P(T<=t) two-tail	0.1073	
t Critical two-tail	2.0369		t Critical two-tail	2.0369	

The statistics presented here were calculated using the Microsoft Windows_{TM} Excel program, Data Analysis tools: t-Test: Paired Two-Sample for Means analysis tool and formula. This analysis tool and its formula perform a paired two-sample student's t-test to determine whether a sample's means are distinct. This t-test form does not assume that the variances of both populations are equal. A paired test can be used when there is a natural pairing of observations in the samples, such as when a sample group is tested twice — before and after an experiment.

Conclusions

Devices able to reliably measure the changes in the electromagnetic field of the body as a result of an interventional therapy, i.e. acupuncture stimulation, will perhaps be helpful in evaluating the efficacy of other therapies, thus eventually reducing costs, and improving the results of the applied therapy by customizing it to the individual patient's response. Also, because stress is a potent contributor to many of the conditions that affect health, such powerful measurement systems are invaluable tools for gathering and interpreting stress-related information as a preventative medicine tool. Both of the MSA-21 and the GDV devices, as seen by the results of this study, can be used to conduct a comprehensive meridian stress assessment and to determine appropriate ways to achieve healthy energetic balance.

1. The GDV instrument was readily able to distinguish authentic acupuncture needling from sham acupuncture needling and
2. For healthy subjects, the GDV instrument detected a larger response to authentic needling compared to sham needling on the right side of the body relative to the left. This body asymmetry effect could be related to the direction of Qi-flow through the body and the relationship between the mental physical manifestation through the right and left hands.

References

1. Tiller, W.A., (2001), *Conscious Acts of Creation: The Emergence of a New Physics*, Pavior Publishing, CA.
2. National Institute of Health, (1997), *Consensus Statement Online*.
3. BioMeridian™ MSA-21 device
4. Korotkov, K., (1998), *Aura and Consciousness; New Stage of Scientific Understanding*, Kultura, St. Petersburg Division of Russian Ministry of Culture.
5. Voll, R., (1975), *Twenty Years of Electro-Acupuncture Diagnosis in Germany. A Progress Report*, *American Journal of Acupuncture 3*, 7-17.
6. Tiller, W.A., (1989*),* "On the Evolution and Future Development of Electrodermal Diagnostic Instruments", *Energy Fields in Medicine*, Eds. M. A. Horton and C. Dloohy, Fetzer Foundation, Kalamazoo, MI.
7. Rosendal, T. (1944), Further Studies on the Conducting Properties of Human Skin to Direct and Alternating Current, *Acta Physiol. Scand*. *8*, 183-202, and *9*, 39-49, (1945).