Psychological Mechanism of Traditional Healing Technique Performed by the Healing Robot -through the life information field-

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Abstract: One of the characteristic healing techniques of Traditional Indian Medicine (Ayurveda), Shirodhara (oil dripping treatment on the forehead), was studied by a new modern approach with a healing robot, which provided the standardized reproducible method for Shirodhara.

16 healthy subjects (1st experiment) and 57 healthy subjects (2nd experiment) had Shirodhara with the monitoring of the physiological examinations in the 1st experiment, and the psychometric questionnaires (STAI and altered state of consciousness: ASC) in the 2nd experiment.

During Shirodhara, heart rate and CO₂ excretion decreased, and an alternative marker of sympathetic tone, LF/HF ratio calculated from ECG R-R variability, was suppressed. In the EEG study, wave was predominant in the frontal lobe, and frontal midbrain wave appeared during Shirodhara. These physiological changes were supported by the anxiolytic effects of the 2nd experiment associated with altered state of consciousness in the Shirodhara conducted by the healing robot. Both anxiolytic effects and depth of altered state of consciousness are correlated with the skin temperature of the foot during Shirodhara, which indicated the linkage of the physiological and psychological dynamics during Shirodhara.

According to the Ayurvedic concept of life, Shirodhara may at first alter the state of consciousness of the inner side of the mind, resulting in the decrease of anxiety of mind level, which was manifested as the suppression of sympathetic nervous activity and the elevation of the foot skin temperature in the body level. The level of consciousness is said to be the life information filed. This mechanism of manifestation of the information field through mind and body level is so similar to biotechnology of the modern medicine, that we call it “Spiritual Biotechnology”.

Key words: Shirodhara, healing robot, altered state of consciousness, Spiritual Biotechnology

1. Introduction

Shirodhara is one of the typical oil treatments originated from India. “Shiro” means head and “Dhara” means dripping in Sanskrit language. Shirodhara is a well known healing techniques in the Traditional Indian Medicine (Ayurveda). It has long been prescribed against insomnia, headache, anxiety neurosis, depression, Schizophrenia, motor neuron disease, hypertension and several kinds of psychosis. Shirodhara is the method of dripping some medium such as medicated sesame oil on the forehead for several ten minutes as shown in Fig. 1. Few reports on the physio-psychological changes during Shirodhara have yet been reported so far, and also the psychological effects of Shirodhara have not been cleared.

In order to overcome one of the critical problems in the study of Ayurvedic oil treatments, we have developed a healing robot which conducts Shirodhara in a computerized reproducible manner. We studied the physiological changes during Shirodhara conducted by the technicians at the 1st experiment, thereafter, the psychological experiences during Shirodhara were assessed by the psychometric studies of anxiety and altered state of consciousness (ASC) in the 2nd experiment which used the healing robot.

Usually in the Oriental Medicine, not only patients but also practitioners are included in the important factors for the treatments. We have also checked the physiological changes of the practitioners themselves in the 1st experiment.
2. Methods

A. Experiment 1: Physiological changes of both subjects and technicians during manual Shirodhara

Sixteen healthy adult females (age 21 – 56: 33 ± 9 years old) provided informed consents and participated in the study. They had no mental disease, nor neuropsychological disorders. Pre-treatment control period and post-treatment period were set for 15 minutes, and Shirodhara treatment session was 20 minutes long (Fig.3). The same subjects participated twice in the control and active studies at four-day intervals in a randomized order.

Monitoring items during Shirodhara were blood pressure (continuous blood pressure monitoring; ANS508 by Nippon Colin Co., Ltd.) and intermittent blood pressure (automatic sphygmomanometer; Paramatek GP303S), ECG R-R intervals, expired gas analysis (MetaMax from Marcotek Co., Ltd.), impedance cardiography (Nicoview from NEC) and EEG (F3, F4, P3, P4 or 16 points electrodes; Neurofax by Nihon Kohden Co., Ltd.) of the subjects. The single EEG (C3 lead) of the technician was recorded at the same time (Fig.2). Respiratory movement of the chests of both subject and technician were also recorded. Shirodhara was performed by the machine which has the pumping and heating system. The tip of oil tube was manipulated by the technician in the same manner as possible. The oil used was the plain cold-pressed preheated sesame oil (Kadoya Oil Co., Ltd.). The flow rate (2.1 - 2.6 L/min) and temperature (39 ± 1 °C) of the sesame oil were kept as steady as possible.

Power spectral analysis of R-R variability was performed to assess the balance of autonomic nervous system. HF (high frequency) was power spectral density (PSD) from 0.04 to 0.15 Hz, and LF (low frequency) was the PSD from 0.15 to 0.40 Hz6-7. Coherence or spectral distribution of EEG and respiratory movements were calculated by the computer soft program named BIMUTUS II (Kissei Comteck Co. Ltd).

B. Experiment 2-1: Physio-psychological changes during Shirodhara by the healing robot in relation to anxiety and altered state of consciousness (ASC)

57 healthy volunteers (age 33 ± 8 y.o.: 22 - 46 y.o.) participated in this study with the healing robot after providing signed informed consents. In this study...
experiment, treatment was regulated automatically by the computerized system of the healing robot (Fig.4, 5). Temperature (39.0 ± 0.2 °C) and flow rate (2.3 ± 0.2 L/min) of the oil were kept constant in both manual and robot systems; however, minute regulation was possible in the healing robot. The robot system can keep the same reproducible dripping speed and pattern. The oil used was the same plain cold-pressed preheated sesame oil (Kadoya Oil Co., Ltd.). Pre-treatment control period was set 10 minutes long and Shirodhara treatment session was fixed 25 minutes long (Fig.6). The pattern of dripping sesame oil was as follows; eight knot 5 min, horizontal 5 min, vertical 5 min, and again eight knot 4 min, horizontal 4 min, and vertical 4 min. The nozzle of oil moved at the speed of 1.5 cm/s. These conditions were decided from the experiment 1. The subjects’ skin temperature of the right neck, right hand and right foot was monitored throughout Shirodhara. The psychological changes were assessed by the psychometric studies including State-Trait-Anxiety Inventory (STAI) before and after Shirodhara, and ASC questionnaires just after Shirodhara (Fig.6).

The validity of the ASC questionnaire was ascertained by Saito(9). The questionnaire asked about experiences of altered states of the consciousness in ten domains (Table 1). The average scores of these 10 domains were calculated from 60 questions.

1. Loss of Space Perception: feeling like floating
2. Loss of Time Perception: no notice of time passing
3. Loss of Speech Sense: no mood for saying words
4. Tranca: scattered
5. Concentration: no notice of any change in surroundings
6. Cosmic Consciousness: experience such as to have seen truth
7. Passiveness: feeling like being under someone’s control
8. Momentariness: feeling like only a short period of experience
9. Loss of Difference between Subjectivity and Objectivity: no separation between oneself and others
10. Loss of Bodily Sense: feeling like only mind existing without body

Toshimasa Saito, Researches on ASC, Shouki sha, Kyoto, 1981

Table 1. 10 domains of ASC in the Psychometrics

<table>
<thead>
<tr>
<th>Domain</th>
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Questionnaires (Psychometric study)
- STAI
- POMS
- ASC (60 questions)

(STAI: State Trait Anxiety Inventory, POMS: Profile of Mood State)

Fig.6 Time table of the physio-psychological monitoring during Shirodhara by the Healing robot (2nd experiment)

C. Experiment 2-2: Anxiolytic effect of Shirodhara

At first 57 subjects (32±6 y.o. : 23~37 y.o) had STAI Spielberger's STAI:state-trait anxiety inventory(9) before and just after Shirodhara.

At the next step (experiment 2-2), 10 of 57 subjects who had abnormally high STAI scores participated in the experiment 2-1. State anxiety over 40 was set as the criteria for abnormal score groups. These 10 females (30 ± 6 y.o. : 23 - 35 y.o.) had 25 minutes' Shirodhara once every week four times in a month. The conditions to regulate the healing robot were the same as those in the experiment 2-1.

POMS (Profile of Mood States) scores were also assessed before and after Shirodhara (Fig.6). POMS was developed by McNair et al. Its validity was ascertained(10,11). POMS has 5 kinds of domains; tension and anxiety, depression, anger and hostility, vitality, exhaustion, confusion.
D. Statistical analysis:
Regarding physiological examinations, paired-t-test, and one or two way ANOVA were adopted, while psychological questionnaires such as STAI or POMS were analysed by Wilcoxon’s singed rank test. The correlation between nonparametric parameters were calculated Spearman’s method. However the average of the scores of psychological outcomes were analysed as consecutive numbers and Pearson’s correlation coefficients were calculated. In every study, the p value of significance was set under 0.05.

3. Results
A. Standardization of Shirodhara
In the manual Shirodhara, oil weight was 16 g at forehead from the nozzle of 20 cm high. In the Shirodhara by the Healing robot, the same weight of oil was obtained at 20 cm high in the flow of 2.3 L/min (Fig.7). The diameter of the nozzle was 8 x 8 mm. This program of controlling the healing robot was adopted as the standardized method.

Manual method: 30 cm high = 20 g ● 20 cm high = 16 g ★ (oil flow 2.3 L/min)
Healing robot: diameter of the nozzle 8 x 8 mm

![Fig.7 Weight of the poured sesame oil](image)
Oil was poured on the weigh.

B. Physiological results by the manual Shirodhara
In the experiment of manual Shirodhara, the heart rate and consumption of CO₂ were compared with the control studies of the same subjects. As shown in the Fig.8, heart rate decreased significantly just 5 minutes after starting Shirodhara, while there were no significant changes in the control study. Similar to the heart rate, CO₂ excretion and tidal volume were also decreased during Shirodhara, while there were no significant changes in the control study (Fig.9,10).

4 of 16 subjects had some troubles such as headache during Shirodhara due to bed rest or keeping the same position. Their data were excluded from the analysis. Data from 12 subjects (age 22 - 56:33 ± 8 y. o.) was analysed.

The autonomic nervous balance of the subjects were also measured by means of ECG R-R variability (LF/HF and HF power of the R-R variability). The 6 subjects who have respiration rates under than 0.1 Hz were excluded from the analysis because LF and HF components overlapped when respiration rates were under 0.1 Hz. The results showed LF/HF ratio, an alternative index of cardiac sympathetic activity, was suppressed during and after Shirodhara (Fig.11). However, HF power, an index of the parasympathetic nervous tone, changed in the similar trend in both active and control studies (Fig.12).

Regarding change of the EEG mapping by Shirodhara, α wave-power dominance shifted from the occipital region to the frontal region during Shirodhara. After the Shirodhara, α wave was again dominant in the occipital region (Fig.13) in a typical case. Simultaneously, α wave coherence was also increased during Shirodhara (data not shown).

We measured simultaneously the EEG findings of two handlers of the manual Shirodhara machine (Fig.14). C3 lead of them showed relative increase of β wave power and relative decrease of α wave power in the active experiments, while there were no significant changes in the control studies.

![Fig.8 Change of heart rate during Shirodhara](image)
The same subjects participated in both active and control studies.

![Fig.9 Change of CO₂ output during Shirodhara](image)
The same subjects participated in both active and control studies.
International Society of Life Information Science (ISLIS)

Journal of International Society of Life Information Science (ISLIS)

The Seventeenth Symposium on Life Information Science
March 13-14, 2004, Tokyo Denki University, Tokyo

**C. Psychological results by the healing robot**

(1) ASC experiences during Shirodhara

ASC (altered state of consciousness) is usually misunderstood as peculiar experiences induced by psychotropic drugs. Traditional healing techniques such as meditation and oil massage often induce ASC. Saito classified the ASC into 10 kinds of experiences (10 domains) as shown in the table 1, and he made up the ASC questionnaire after ascertaining its reliability and specificity. We used the questionnaire developed by him and asked the subjects the ASC questionnaire just after Shirodhara.
The level of the experiences was categorized into 5, and over 4 indicated ASC experience. 46 of 57 subjects (81%) who had Shirodhara experienced some kinds of ASC. Average scores of each domain was shown in Fig.15.

Fig. 15 showed the highest average scores of ASC were obtained in the domains of trance, passiveness, timeless sensation, wordless sensation, concentration.

(2)Correlation between ASC or anxiolysis and skin temperature of foot and hand
The correlation between mean ASC score and anxiolytic effects was not so high but significant correlation was obtained (Fig.16: \( r = -0.34, p < 0.01 \), Spearman’s correlation coefficient; c.c.).

The same correlation was obtained between mean ASC score and mean skin temperature of the foot in the latter half of the Shirodhara (Fig.17: \( r = 0.35, p < 0.01 \) Spearman’s c.c.). The mean skin temperature of the foot in the latter half of Shirodhara is also correlated with decrease of state anxiety (Fig.18: \( r = 0.37, p < 0.01 \), Pearson’s c. c.). The skin temperature of the right hand or right neck had nothing to do with ASC nor anxiety.

(3)Anxiolytic effects of Shirodhara in the subjects with high anxiety
10 of 57 subjects with high state anxiety (40) had successive Shirodhara 4 times every week. The changes of POMS score were assessed after final Shirodhara. The result indicated significant decrease of tension & anxiety (Wilcoxon signed rank test, \( p < 0.05 \)) and a tendency to decrease exhaustion (Fig.19). Concerning other domains, the average level showed better changes without significance.
Density

Fig. 19 Psychological effects of successive Shirodhara.
The subjects had abnormally high anxiety level by STAI. Their tension and anxiety decreased significantly after 4 times of Shirodhara for 1 month.

D. Summary of results
1. Shirodhara induced bradycardia and lowered tidal volume and CO₂ output.
2. During Shirodhara sympathetic nervous tone was suppressed, while parasympathetic nervous tone was the same as that in the control study.
3. EEG during Shirodhara showed an increase of slow α and θ or θm waves. Shirodhara induced an increase of right-left EEG coherence. These results indicated restful alertness in which frontal lobe, limbic system and medulla oblongata were activated.
4. There were no cases of headache or skin eruption which was directly related to Shirodhara. However some cases complained of compression discomfort of the occipital region, or numbness of extremities or lower back which were not directly attributed to Shirodhara.
5. The technicians of Shirodhara showed stressful condition which was speculated from their EEG findings. There was no coherent respiratory movement of the subjects and technicians.
6. Shirodhara induced altered state of consciousness and it reduced anxiety as well. The subjective anxiolytic effects and depth of ASC were correlated with the objective increase of the skin temperature of the foot.
7. Successive Shirodhara reduced tension and anxiety of anxious subjects in one month.

4. Discussion and Conclusion

The subjective feelings during Shirodhara showed deep restfulness with less anxiety, as if the subject may be fallen in the gap between sleep and awake in ASC states. Shirodhara induced bradycardia and relative suppression of LF/HF power spectrum density, which indicated lowered sympathetic tone.

Expired gas analysis showed decreased tidal volume and CO₂ excretion. EEG showed slowing of α wave and an increase of α and θ activity, and an increase of right - left coherence. These metabolic, ECG and EEG findings supported the well known relaxing and low metabolic state during Shirodhara. The physiological changes during Shirodhara were similar to those of mediation. α dominance in the frontal area, decrease of heart rate and CO₂ excretion. These findings indicated change of the function of frontal lobe, limbic system, brain stem and autonomic nervous system.

On the other hand, EEG of technicians of manual Shirodhara showed their stressful condition, which may also justify the utility of the healing robot as the assistant of the technicians.

Regarding mechanism of actions of Shirodhara, two hypotheses may be speculated as follows.

<Neurophysiological mechanism>
The neurophysiological mechanism of the effects of Shirodhara on the psycho-physiological changes may be related to the tactile stimulation of the skin or hair follicles innervated by the first branch of the Trigeminal nerves (Ophthalmic nerve) (Fig. 20). The impulses would be transmitted to the thalamus through the Principal nucleus, forward to the cerebral cortex (somato-sensory field) or limbic system (Fig. 21). These routes would provide the subjects ASC experience and relieving of anxiety.

Other routes from the Principal nucleus to the reticular formation and posterior region of thalamus which is the center of autonomic nervous system would be possible. These latter routes would provide us changes of sleep and changes of autonomic nervous balance, such as R-R variability and skin temperature of the foot.

Fig. 20 Sensory domains of Trigeminal nerve
Shirodhara stimulates just the skin innervated by the 1st branch of the Trigeminal nerve.
Both anxiolytic effects and depth of altered state of consciousness are correlated with the skin temperature of the foot during Shirodhara, which indicated the linkage of the physiological and psychological dynamics during Shirodhara.

The physiological changes were supported by the anxiolytic effects of the 2nd experiment associated with altered state of consciousness in the Shirodhara conducted by the healing robot.

According to the Ayurvedic concept of life, Shirodhara may at first alter the state of consciousness of the inner side of the mind, resulting in the decrease of anxiety of mind level, which was manifested as the suppression of sympathetic nervous activity and the elevation of the foot skin temperature in the body level.

The level of consciousness is said to be the life information filed. These mechanism of manifestation of matter depending on biotechnology is so similar with one of Ayurvedic mechanism of manifestation that we call it "Spiritual Biotechnology".

Shirodhara may be the oldest but the most skillful healing technique which manipulate cerebral function and state of consciousness. It may provide a new tool and new knowledge for the modern brain research of consciousness. Furthermore it may open new paradigm of Spiritual Biotechnology.

5. References


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伝統医学的療法による変性意識体験と癒しロボットの効果の仕組み
- 生命情報のレベルからのアプローチ -
(Psychological Mechanism of Traditional Healing Technique
Performed by the Healing Robot
-through the life information field-)

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要旨: 伝統医学の代表的なリラックス法である頭部滴油療法 (シロダーラー) の心理的・生理的効果について調査し、伝統医学の生命観に従って効果の仕組みを考察した。まず健常成人16名を対象として、文章による同意を取りまとめ、オイル循環装置を使い、頭部滴油療法を用いて行った。同じ被験者が、無作為の順序で、臥位対照実験に参加した。その結果、頭部滴油療法により、脳波におけるα波の前頭部へのシフト、1回換気量や二酸化炭素排泄量の有意な減少、心拍数の有意な減少など、対照実験では認められなかった変化を頭部滴油療法において認めた。

次に、57名の被験者を対象にして、前の実験と同じ条件下で施術する癒しロボットを試作し、全員同じ条件 (オイル温度、オイル流量、オイル滴下パターン、オイル滴下部の移動速度) で施術した場合の、心理的変化について、斎藤らの開発した変性意識体験問診表、不安度検査表 (STAI) を使って調査した。また、頭部、手背部、足背部の皮膚温度も熟対応を使って連続測定した。その結果、施術者の80％近くが、何らかの変性意識体験をしており、状態不安の低下も有意なものであった。さらに変性意識体験の深さは、不安度の低下とも有意に相関した (r = 0.34, p < 0.01, Spearman's method)。また、変性意識体験の深さと足背部皮膚温との有意な相関性を示した (r = 0.35, p < 0.01, Spearman’s method)。

伝統医学に古代インドの生命観では、意識→心→肉体という具象化の過程を経てしている。頭部滴油療法の効果も、意識のレベルの変化を起こし、それが不安度の低下という心の変化を起こし、その結果、肉体的に足背部皮膚温の上昇という結果をもたらすものと推定された。このような意識 (情報) →心 →肉体という具象化のプロセスを、「Spiritual Biotechnology」と呼ぶことを我々は提唱したい。それは、現代医学的、ゲノム (情報) → プロテオーム → 肉体という Biotechnology と酷似している具象化のプロセスであるからである。このような現代医学の概念と対応させて、伝統医学的治療法の効果の仕組みと活用方法の発展、さらには現代医学の発展をもたらすことができるのではないかと思われる。

Key words: Shirodhara, healing robot, altered state of consciousness
Spiritual Biotechnology