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A comparative study to assess the modulation of stress by *Shirodhara* in healthy individuals by psychometric and heart rate variability measures

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ABSTRACT

Aim: Psychological stress is one of the risk factors for psychosomatic disorders and *Shirodhara* has been a standard treatment procedure for many such conditions in Ayurveda. Different liquid media are used for *Shirodhara*, which has not been explored extensively. In this study, we used heart rate variability (HRV) measures and subjective questionnaires for assessing the effects of *Shirodhara with either takra (buttermilk) or jala (water) on* psychological stress in normal healthy individuals.

Methods: Thirty-six healthy male subjects aged between 25 and 36 years were recruited for this study (2017–2018). The recruited subjects were assessed with baseline parameters: perceived stress scale (PSS), Depression, Anxiety, Stress Scale (DASS-21), World Health Organization (WHO) well-being questionnaire, and HRV assessment by recording resting electrocardiogram for 15 minutes. The subjects underwent continuous 5 days *Shirodhara* with medicated *Takra* (buttermilk, *n* = 18) or *Jala* (water, *n* = 18) during afternoon at the Ayurveda facility. After 5 days, all the parameters were re-assessed.

Results: The subjects who underwent *Shirodhara with Takra* showed significant decrease in HR and root mean squared standard deviation (RMSSD). However, the age-matched subjects who underwent *Shirodhara* with *Jala* did not show statistically significant changes in these parasympathetic parameters in HRV. On psychometric assessments: sleep quality, PSS, and WHO well-being scales, subjects in both groups (*Takra* and *Jala*) showed significant improvement. DASS 21 scales showed improvement in *Takra* group only.

Conclusions: These results suggest that 5 days of *Shirodhara lead to* modulation in autonomic balance along with stress reduction and improved well-being, particularly in those who underwent *Shirodhara* with *Takra*.

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Introduction

Physical, social, and mental well-being have always been serious concerns for both individuals and the community. Since maintaining optimal health is a necessity for cognitive efficacy, proper maintenance of routine day-to-day activities, dealing with stressful world, and greater work efficacy are the need of the hour [1]. The modern lifestyle has lots of components that affect the health of individual directly or indirectly. The World Health Organization (WHO) defines health as not merely absence of disease but having sound physical, mental, and social well-being [2]. This has already been emphasized in Ayurveda philosophical principles as it covers the well-being of body, mind, and spiritual aspects [3]. Traditional systems of medicine have had an important role for health in human history and they seem even more important in today's stressful world. *Ayurveda* (*Ayur* means life and *veda* is knowledge, thus it means the "knowledge of life") is one such Indian traditional system of medicine with deep historical roots, which is more than 5,000 years old [4]. The definition of

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health, maintenance of health, and the regimen to follow to lead a healthy living is mentioned in literature of Ayurveda as "Sadvrittha" [5]. Ayurveda can be perceived as a holistic system of medicine as it comprehensively evaluates all systems of the body and its response to any disease-causing imbalances [6]. Furthermore, it stresses on the prevention of diseases, as well as provides information of curing of acute and chronic disorders. In the classical literature of *Ayurveda*, different kinds of treatment procedures, medicinal application, and routes of drug administration are mentioned [3,5,7]. One such representative *Ayurveda* intervention which is being used since a long time for both healthy as well as diseased state is *Shirodhara*. *Shirodhara* (*Shiro*: head, *dhara*: dripping) involves streaming of medicated liquid medium over forehead. The streaming media can be water (*Jaladhara*), buttermilk (*Takradhara*), milk, oils, and various medicated decoctions [8,9]. *Shirodhara* is mentioned as being useful for various neurological and psychiatric disorders in classical textbooks [10,11]. *Shirodhara* has been used in healthy individuals also as a way for relaxation. A relaxed mind and body will be helpful for disease prevention and disease recovery.

Visceral systems of the body are being regulated by autonomic nervous system (ANS) which consists of two divisions: sympathetic and parasympathetic. The balance between these two divisions in modulation of heart rate (HR) has been assessed by short term heart rate variability (HRV). This tool has been used by in a previous study to assess the transient effect of *Shirodhara* with oil [12]. HRV has also been used for assessing mental stress [13]. How stress alters the HRV in otherwise "healthy" population and how the technique of *Shirodhara* modulates the level of stress-induced changes on HRV and other neurophysiological measures is one of the objectives of the current study. A previous study has reported that *Shirodhara* enhances the psychological profile of individuals [12]. We hypothesized that neurophysiological measures, including ANS and psychometric scales, will show changes after *Shirodhara* techniques. Hence in this study, we investigated neurophysiological changes as assessed by HRV, questionnaires on psycho-physiological well-being, emotional levels, and sleep quality before and after *Shirodhara* intervention.

Very few studies have measured neurophysiological changes caused by *Shirodhara* [14,15]. Particularly, the effects of *Shirodhara* with medicated buttermilk—*Takradhara,* and water—*Jaladhara*, described in classical *Ayurveda* scriptures, on well-being and different ailments are less explored compared to other streaming media [8,15]. In the same vein, an isolation of the physical effects of dripping on the forehead from the pharmacological effects of different dripping media has not been thoroughly studied. Hence, we planned this study to assess the effectiveness of *Shirodhara* on neurophysiological parameters and psychological well-being in healthy male human volunteers after 5 days of two types of *Shirodhara* intervention: *Takradhara* and *Jaladhara*.

Methodology

The study was approved by the Institute Ethics Committee. Thirty-six male healthy volunteers (aged between 19 and 36 years) were randomly chosen and grouped according to age. The study was carried out in the year 2017–2018. The subjects were explained about the procedure and informed consent was obtained. The subjects were free from physical illness and were not on any medications acting on the central nervous system. Subjects with a personal history of sleep disorder, respiratory or cardiovascular problems, psychiatric illness, or neurological illnesses were excluded. Subjects were also clearly instructed not to take any central nervous system stimulants (to be abstinent for at least 1 week prior to the study) or caffeine (for at least 3 hours prior to the study).

Study design

This was an open label, comparative, and prospective study. The healthy volunteers (N = 36) were randomly grouped into 2 groups of 18 each. The assessments were conducted in autonomic function test laboratory (AFTL) and the *Shirodhara* intervention was done at the Ayurvedic facilities of institution. All the participants were encouraged to visit the AFTL and treatment facilities to acquaint them with the laboratory and treatment set-up prior to the actual recording session.

Baseline parameters were assessed [HRV with electrocardiogram (ECG) from AD instrument device and perceived stress scale (PSS), WHO-5 Well-being questionnaire (WHO-5), depression, anxiety, stress scale (DASS-21), and Pittsburgh sleep quality index (PSQI) questionnaires]. Although these questionnaires were ideally to be administered with a gap of 15 days, since we had 5 days of session of *Shirodhara*, we repeated these in the beginning and end of 5 days of session. From next day onwards, *Shirodhara* session with medicated buttermilk

(for *Takradhara* group) or warm tap water (for *Jaladhara* group) was done during evening hour slot due to logistic availabilities as all morning (ideal time for the *Shirodhara* sessions) hour slots are booked for patient treatment. Each session of 30 minutes was administered for five successive days. Subjects were advised to avoid tea and coffee 3 hours before the procedure. The procedures were well explained to subjects, a cloth is tied over the eyebrow, eyes and ears are protected with cotton pad and plug, respectively. After the procedure, the eye pads, earplugs, and headband were removed. A towel was used to dry the hair. Rasnadi choorna was used to apply over bregma after the above procedure. Following the procedure, 1 hour of rest was advised to subjects. Next day after the last session, all the parameters (15-minute artifact-free ECG and questionnaires) were re-assessed.

Heart rate variability measures

Resting HR and blood pressure (BP) were recorded in Autonomic laboratory under standardized conditions [16]. Subjects were advised to abstain from alcohol and nicotine for 24 hours before evaluation. The test was performed in a silent environment at room temperature (22°C–26°C), between 8 and 11 am. Patients were advised to take light breakfast 2 hours prior to the tests and empty bowel and bladder before the tests. They were familiarized with the laboratory settings and briefed about the tests. Recordings were done after 30 minutes of supine rest. Although HRV is highly varying parameter affected by both internal as well as external environment, we tried to minimize the alterations by recording in as uniform conditions as possible. ECG was recorded with lead II and was conveyed through analog to digital converter (power lab, 16 channels data acquisition system, AD Instruments, Australia) with a sampling rate of 1,024 Hz, MLS 310 Module was used to analyze the different HRV measures. HRV was recorded and analyzed as per the guidelines of Task Force report [17]. It was ensured that the patients were breathing at normal respiratory rate of 12–15 breaths/minute by requesting the patient to breathe normally. The data were stored in PC and analyzed offline using an automatic program that allowed visual checking of raw ECG signals.

Statistical methods

Descriptive statistical analysis was carried out in this study. Results on continuous measurement are presented on mean ± SD and results on categorical measurements are presented in % and median (interquartile range). Significance was assessed at 5% level of significance. For assessing any baseline difference between groups, independent "*t*" test was carried out between the baselines of two groups. 2 * 2 Repeated Measures analysis of variance (RMANOVA) was used to find the significance of study parameters within and between subjects. Simple main effects assessment was used to check any significance between groups and significance between time periods. We have applied above-mentioned statistics for all the repeated measures such as short-term HRV parameters, BP, and psychometric scales.

Results

Results are as shown in Tables 1 and 2. The results of time domain measures of HRV RMANOVA indicate that there was a significant decrease in HR and significant increase in RMSSD, NN50, and pNN50. All other parameters showed no significant difference in pre- and post-*Shirodhara*. To compare the differences between the groups (*Takradhara* and *Jaladhara*), we analyzed the simple main effects between the groups (Table 1). These results indicate that there was significant decrease in HR and significant increase in mean NN, RMSSD, NN50, and pNN50 in the *Takradhara* group. There was no significant change in any of these time domain measures in *Jaladhara* group. To compare the simple main effects of time (*Jaladhara vs. Takradhara*) of time domain measures of HRV, we analyzed one-way ANOVA and found no significant differences in pre- and post-values of both the groups. No significant change was observed in the time point comparison of the two groups.

When RMANOVA was applied to compare the frequency domain measures in within as well as between-subject effects, there was significant within subjects' effect for HF power, LF power nu, HF power nu, and LF/HF ratio (Table 1). There was no significant between-subject effect for any of the frequency domain measures. To compare the effects between the groups, we performed one-way ANOVA and found that there was a significant increase in HF power and HF nu in *Takradhara* group. There was also significant decrease in LF nu and LF/HF ratio. To compare the simple main effects of time (JD *vs.* TD) of frequency domain measures of HRV, we analyzed using one-way ANOVA and found no significant differences in pre- and post-values of

Table 1. Heart rate variability (HRV) measures before and after *Takradhara* (TD) and *Jaladhara* (JD).

Parameters	*Takradhara* (TD, *n* = 18)		*Jaladhara* (JD, *n* = 18)		Within subjects ANOVA		Between subjects ANOVA		Simple main effect JD (D1 *vs* D5)		Simple main effect TD (D1 *vs* D5)	
	Pre	Post	Pre	Post	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*
HR	74.24 ± 7.56	67.14 ± 7.54	71.57 ± 5.95	70.48 ± 9.27	17.31	<0.001	0.016	0.89	0.51	0.48	28.7	<0.001
SDNN	60.09 ± 1.94	65.35 ± 28.78	54.90 ± 14.84	61.49 ± 26.78	3.29	0.07	0.39	0.53				
RMSSD	40.18 ± 18.21	53.38 ± 24.77	48.75 ± 18.50	60.05 ± 46.56	9.07	0.004	0.73	0.39	2.15	0.16	25.34	<0.001
pNN50	17.73 ± 14.73	29.49 ± 20.78	25.18 ± 14.83	29.84 ± 23.48	15.29	<0.001	0.43	0.51	2.14	0.16	18.47	<0.001
Total power	3,892.9 ± 2,427.5	4,734.0 ± 3,733.0	3,134.7 ± 987. 7	4,154.2 ± 3,590.0	4.14	0.04	0.55	0.46	2.03	0.17	2.18	0.15
LF power	1,207.3 ± 984.3	1,168.9 ± 810.4	869.05 ± 513.6	1,112.7 ± 580.3	0.86	0.35	0.78	0.38				
HF power	737.5 ± 597.5	1,309.0 ± 1,180.7	731.4 ± 747.1	1,122.7 ± 1,191.4	14.12	<0.001	0.10	0.74	4.07	0.059	11.62	0.003
LF nu	59.84 ± 11.72	48.71 ± 12.32	47.91 ± 13.14	50.02 ± 15.51	10.11	0.003	1.60	0.21	0.84	0.37	45.92	<0.001
HF nu	33.42 ± 10.44	45.78 ± 11.95	34.73 ± 13.02	36.58 ± 13.24	27.49	<0.001	1.05	0.31	0.79	0.38	50.08	<0.001
LF/HF ratio	2.04 ± 0.90	1.21 ± 0.63	1.56 ± 0.70	1.607 ± 0.93	21.23	<0.001	0.02	0.87	0.14	0.71	37.80	<0.001

HR= heart rate; SDNN = standard deviation of Normal to Normal intervals; RMSSD = root mean square of standard deviation; pNN50 = percentage of adjacent NN differing more than 50 ms; LF = low frequency; HF = high frequency; nu = normalized units.

Table 2. Psychometric measures before and after *Takradhara* and *Jaladhara*.

Parameters	*Takradhara* (TD, *n* = 18)		*Jaladhara* (JD, *n* = 18)		Within subjects ANOVA		Between subjects ANOVA		Simple main effect (JD) D1 *vs* D5		Simple main effect (TD) D1 *vs* D5	
	Pre	Post	Pre	Post	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*
PSQI	5.36 ± 3.41	2.57 ± 2.61	5.15 ± 2.42	3.21 ± 1.93	46.76	<0.001	0.07	0.79	20.63	<0.001	26.30	<0.001
PSS	20.84 ± 4.40	13.57 ± 4.08	18.26 ± 5.10	15.63 ± 4.37	47.15	<0.001	0.04	0.83	7.12	0.01	47.76	<0.001
WHO-5	54.31 ± 14.13	75.36 ± 13.28	60.84 ± 14.14	69.05 ± 11.73	40.79	<0.001	0.0008	0.97	15.50	<0.001	26.63	<0.001
DASS-21D	12 ± 9.18	7.57 ± 7.18	12.31 ± 9.78	10.52 ± 8.98	19.51	<0.001	0.34	0.56	3.19	0.09	20.09	<0.001
DASS-21A	11.78 ± 8.16	6.42 ± 5.01	11.47 ± 9.74	10.10 ± 7.98	14.91	<0.001	0.48	0.49	1.12	0.30	20.86	<0.001
DASS-21S	16.10 ± 11.14	8.21 ± 7.20	13.36 ± 8.56	10.63 ± 8.38	34.84	<0.001	0.003	0.95	6.37	0.02	30.11	<0.001

PSQI = Pittsburgh sleep quality index; PSS = perceived stress scale; WHO = world health organization; DASS = depression, anxiety, stress scale.

both the groups (Table 1). No significant change is observed at both the time point comparison of two groups. In terms of psychological questionnaires, there were significant within-subject effects but no significant between-subject effects (Table 2). A simple main effect ($p < 0.x001$) (day 1 *vs*. day 5) was observed in all the psychological questionnaires in the *Takradhara* group, but only in PSQI and WHO-5 in *Jaladhara* group.

Discussion

In this study, we found that after 5 days of *Takradhara*, there was a significant decrease in HR, LF normalized units, and sympathovagal balance and a significant increase in RMSSD, NN50, and pNN50 in subjects who underwent *Takradhara*. These changes were not observed in *Jaladhara* group. These results suggest that *Takradhara* is enhancing the parasympathetic activity [16,17] and decreasing the sympathetic activity in healthy individuals. There was no significant difference in either systolic or diastolic BP observed in our study before and after the intervention in two groups. This could be explained as the study was conducted in normal healthy volunteers. Their BP before the study was in normal range. This also confirms that both the groups did not show any adverse effect on BP variation. A previous study has demonstrated that *Takradhara* and *Shirodhara* with oil decreased BP but the study was done in patients with hypertension [18]. Hence, our results suggest that *Shirodhara* when performed in healthy volunteers may not lead to any changes in BP.

Pittsburgh sleep quality index

In the PSQI evaluation questionnaire, a significant decrease of the mean value was observed in both the groups, suggesting that both *Takradhara* and *Jaladhara* had a role in enhancing sleep quality. The role of *Jaladhara* has been earlier reported [19]. This suggests that procedure of lying down for 30 minutes with eyes closed in calm environment and getting stream of warm liquid medium has effect on sleep quality enhancement. *Shirodhara* with oil has been used in previous studies to establish the effects on sleep and anxiety levels and was found to have significant effects in decreasing anxiety levels and enhancing sleep quality [20]. In a study conducted by Uebaba et al. [8] using *Shirodhara* with oil and algae pack as control, a significant decrease of sympathetic components and enhancement of parasympathetic component of HRV were noticed in Oil *Shirodhara* group. The novelty of our study is studying the effects of two types of *Shirodhara, viz*., *Takra* and *Jala* which have not yet been studied individually.

Perceived stress scale

In PSS, both the groups showed significant decrease in perceived stress scores. *Takradhara* group showed more decrease than *Jaladhara* group, suggesting that *Takradhara* is more efficient in decreasing perceived stress. In another stress scale, DASS 21 questionnaire-stress component, subjects in *Takradhara* group showed significant stress reduction, but this reduction was not significant in *Jaladhara* group. In one study, the benefit of *Jaladhara* has been mentioned for stress reduction [21]. However, the role of *Takradhara* in stress reduction is a novel finding in our study as there is no prior study on role of *Takradhara* in stress reduction.

WHO-5 scale

Well-being is an important aspect for individuals' enhanced efficacy of daily work and activities. Studies have shown that decreased stress, anxiety, and depression level would increase the well-being of individuals [22]. Our results show a significant increase in WHO-5 well-being score after both types of *Shirodhara*, without any difference between the groups. As enhanced wellbeing is expected to result in better cognition and functioning [23], future studies should check these aspects of *Shirodhara*.

DASS-21 scale

One of the simplest and reliable subjective scale for psychometric analysis is the DASS-21 scale [24]. This scale has depression, anxiety, and stress components. In our study, we found that in *Takradhara* group, significant reduction is observed in the depression, anxiety, and stress components of DASS-21 scale. This is the first study investigating the effects of *Shirodhara* on the DASS-21 scale. The mechanistic basis of this reduction in depression, anxiety, and stress by *Takradhara* needs further study.

Possible mechanisms of action

The mode of action of *Shirodhara* has not been experimentally proved by any previous studies. However, all the studies have mentioned that the *Shirodhara* procedure decreases the HR, BP, and enhances the parasympathetic activity [8]. In our

Figure 1. *Shirodhara* procedure.

study, we have observed a change in subjective and objective parameters in both the groups. However, *Takradhara* seems to have more benefit than *Jaladhara* and this could be due to different types of stimulation or action by two different media. As we have maintained the same temperature for both the mediums, the change in this effect is likely to be due to the contents of the medium. *Takra* (Medicated buttermilk) has a pH of 4.0–4.2 and that of the *Jala* used is of 5.6–5.8. One previous study has mentioned that there are pH sensitive receptors on the skin [25,26]. There could have been possible drug actions which lead to more stimulation for *Takradhara*. In a previous study, mustard oil sensitive receptors (TRPA1) were found in the geniculate ganglion of facial nerve [27] and this was proposed as one of the mechanism for *Shirodhara* with oil. However, in our study, we have removed any oil or butter source from the *takra* preparation (Supplementary Materials: Appendix 1). Hence, it would be unlikely that *takra* activates mustard oil sensitive receptors in our study.

The human forehead has afferent cranial nerve branches, such as supraorbital and supratrochlear branches of the trigeminal nerve and branches of facial nerve [27]. Some previous studies have mentioned that the trigeminal nerve afferent has anastomoses with vagal nerve and also has connection to anterior cingulate nucleus, which is an area for higher cognitive and emotion regulation functions, being part of the Limbic system [27,28]. Furthermore, the auricular branch of Vagus called the Arnold nerve has anastomotic connections with the facial nerve. Thus, stimulation of these nerves by opening the pH-sensitive receptor could result in an indirect stimulation of vagal efferent, which further leads to improved sympathovagal balance which is a marker for relaxation and stress reduction [28].

We observed that *Jaladhara* also had positive subjective effects, which suggests that it has some benefits. We can infer this as we used tap water at a temperature between 39°C and 42°C, with pH between 5.6 and 5.8. This also could stimulate the pH-sensitive receptors on the skin. Since the subject will be lying down for 30 minutes in a completely relaxed state without any disturbance, there could be some effect of relaxation. Thus, changes in autonomic balance could be an indirect effect of relaxation response and improved stress coping abilities enhanced by *dhara* (stream) or could be direct effect on cardiac autonomic centers through parasympathetic afferent activation (Facial and Vagal interconnections). In terms of Ayurvedic pathophysiology (Samprapthi), *Lalata* (Forehead) has a Marma in between the eyebrows and is called *Sthapani* or *Thilasa marma* [29]. This is a *sira marma* type and situated in the location of sixth *chakra* termed "*Aajna Cakra*." *Bhrajaka pitta* which is present at this area helps to transfer the *veerya* present in the pouring medium of *Sirodhara* and as it is a marma, it helps in fast spread of *veerya* of medicine [30].

The ingredients of medicated *Takra* used for *Shirodhara* are *Takra*, *Amla*, and *Musta*, in which *Takra* is the base and is *ushna veerya* and have *rooksha guna*. *Takra* itself is *Kapha dosha hara* due to *ushna veerya* and *rooksha guna* and *Vatha dosha hara* due to *ushna veerya*. The other ingredients: *Amla* and *Musta* which are both *sheeta veerya* and *Laghu*, *rooksha guna* [31,32]. According to *sahasrayoga* text, *Takradhara* helps in condition like "*Keshadeenancha shouklyam*," "*klama*," "*Doshakopa*," "*Shiroruk*," "*Ojakshyaya*," "*Karacharanaparisthodana*," "*Mootradhosha*," "*Sandheenaam vishlathatwam*," "*Hridayaruk*," "*Aruchi*," "*Agnimaandhya*." Also, *Takradhara* is specially indicated for "*karnaroga and netraroga*" [19,33–35].

Thus, the cumulative effect of the drugs and the procedure (slow stream flow and oscillatory dhara movement in calm environment) helps in soothing the mind and gives a sense of wellbeing and enhances the sleep quality. In this study, the mind relaxation has been quantified with HRV and questionnaires.

Limitations of the study

Because of logistic reasons (availability of staff), we were unable to achieve randomization, hold the *Shirodhara* sessions in the morning, and achieve blinding of raters in this study. Although true double-blinding may not be possible due to the visual

and olfactory differences between the *Shirodhara* techniques, future randomized single-blind, placebo-controlled studies may be needed to confirm the findings of this study.

Conclusion

In this study, we have compared two types of *Shirodhara*, *viz.*, *Takradhara* and *Jaladhara* on neurophysiological measures (HRV and psychometric scales) in healthy volunteers. We found that after 5 days of *Takradhara*, there were significant decreases in HR, LF normalized units, and significant increases in RMSSD, NN50, and pNN50. These changes were not observed in the *Jaladhara* group. These results suggest that *Takradhara* enhances the parasympathetic activity and decreases the sympathetic activity in healthy individuals. Although lying down in a relaxed state for 30 minutes and getting a stream of liquid on the forehead was the common mode of relaxation in both the types of *Shirodhara*. *Takradhara* showed better improvement in depression and anxiety scores in the subjects. One of the modes of actions could be involvement of pH-sensitive receptors present on the forehead by *Takra*. Further studies are required to see the potential clinical benefits of these types of *Shirodhara* in patient population and possible modes of action using animal models.

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Appendix 1 (Supplementary Materials)

Takradhara Preparation Procedures

Materials required:

1. Shirodhara device-1
2. Vessels-3 (To prepare *takra*; to prepare Amalaki kwatha; to take out *takra* from droni)
3. Towels: 2
4. Gauze piece (60 cm): 2
5. Amalaki Choorna: 50 g
6. Milk: 500 ml
7. Musta: 25 g
8. Rasnadi Choorna: 5 g

Preparation of the medicine:

a) *Takra*: 500 ml of milk was diluted with four times of water and was boiled with 25 g of skinned and crushed Musta tied in a muslin bag and was reduced to the original quantity of milk. The bag of medicament was taken out and squeezed well. When cooled, this prepared milk was fermented by the addition of little sour curd over it and kept it overnight. Next morning, the fermented medicated curd was churned by adding 100 ml of Amalaki kwatha. The butter was removed completely and this mixture is used for dhara after filtering. b) Amalaki kwatha: 50 g of dried Amalaki fruit boiled with 2.5 l of water and reduced to 750 ml. Five hundred milliliter of Amalaki kwatha was used to mix with buttermilk and 250 ml of that mixture was used to wash the head after the procedure.

Appendix 2

Shirodhara Procedure

As mentioned, 36 subjects were assigned randomly into 2 groups of 18 each and after explaining the procedure and obtaining signature on consent form, one group received *Takradhara* and other received *Jaladhara*. One cloth was used to tie at eyebrow area to prevent flow of medium toward. We have checked the pH of both the medium and also ensure

that both are been poured at temp between 38°C and 42°C. The *Shirodhara* procedure was continued for 30 minutes. In our protocol, this procedure was given for 5 days. Usually, this was administered at evening hours between 3.00 and 5.30 pm. After the procedure, the subject was advised to wipe the hair with towel and keep it dry. After wiping, rasnadi choornam is given to apply over bregma to prevent cold symptoms.