CHAPTER 6

MATERIALS AND METHODS
The present research study entitled ‘Assessment of the Effect of Yoga Therapy on Sinusitis using Infra Red Thermal Imaging System’ is done at the Department of Human Consciousness and Yogic Sciences, Mangalore University, Mangalagangothri, Karnataka under the supervision of Dr. K. Krishna Bhat, Professor and Chairman of the department. The instrument IRTIS-200, which has been used for the present study is brought from Russia to the above department under the project sanctioned to Dr. K. Krishna Bhat by the Department of Science & Technology, Government of India. The sinusitis subjects selected for the present study are the patients who came to the Yoga therapy center in the department for yogic treatment and who were ready to cooperate for the research study.

The assessment of the effect of yoga therapy on Sinusitis is studied on the selected subjects. The sinusitis subjects were finalized after taking the detailed case histories and subjects having the clear symptoms of Frontal Sinusitis are only selected for the present study. The case histories are given in the appendix I (the patient name and address are not given here for the sake of confidentiality; anyhow they are available in the department). 20 subjects of age group 19-53 years were selected for the Experimental group in the study. A control group having 20 subjects of age group 19-52 years is also selected for the research study to compare significance of the result. Yoga therapy was given only to the experimental group for a period of 6 months including follow-up.
The IRTIS recordings were considered as the main parameter for the research study. The IRTIS is a precise scanning infrared device for the measurement and visualization of the thermal field. The instrument IRTIS-200 which is used to record the thermal temperatures of the frontal sinus areas is shown below.
The operation principle of IRTIS-200 is based on scanning of thermal radiation in a field of view of a camera by an optic-mechanical scanner and with a single-element high repeatable IR-receiver with transformation of this radiation into an electrical signal by the analog-digital converter. The camera has mirror-lens optics with a small number of reflecting surfaces, which minimizes losses of the optical system and simplifies its adjustment. This makes it possible to obtain a high repeatability of the geometry of successive frames and uniform sensitivity over the entire frame field.

The IR-receiver of the camera is to be cooled by liquid nitrogen. This ensures a high sensitivity of the camera (better than 0.05°C) even when the camera operates at low temperatures, allows the parameters of the IR-receiver to be stabilized regardless of the ambient temperature, and provides for accurate measurement of absolute temperatures. The interface unit of the device is mounted inside the IR-scanner and can be connected to any computer. The thermograms of the scanned object will be recorded in the computer disk. During the present study, to record the thermal temperatures, the patient is asked to sit facing towards the IRTIS Camera at a distance of one meter as shown below. The face of the patient will be scanned to find out the thermal temperature of the frontal sinus area.
IRTIS can indicate abnormality based on variations in temperature. Increased temperature can be found over the areas involved with metabolic variations due to inflammatory process. IRTIS can show an increase in temperature at the areas of the sinuses where there is an inflammation. Therefore, thermal temperature of a spot in frontal sinus area can be studied to find out the efficacy of yoga therapy. However, naturally there will be a temperature variation in different parts of the body. Similarly, other external factors may also affect the body temperature. To nullify this, the difference between the thermal temperatures of a point (near supra-orbital foramen) in frontal sinus area (say ‘spot 1’) and a near by point (say ‘spot 2’), 1.5cm vertical distance from ‘spot 1’ can be calculated by recording the thermal temperatures of these two points. This difference can be used to measure the efficacy of yoga therapy.

The blood tests for E.S.R (Erythrocyte Sedimentation Rate), T.C (Total White Blood Cell Count) and D.C (WBC Differential Count) were considered as the other parameters for the study. The erythrocyte sedimentation rate (ESR) is the rate at which the red blood cells precipitate in a period of 1 hour (mm/hr). It is a common hematology test which is a non-specific measure of inflammation. ESR will be increased by any cause or focus of inflammation. Normal values for ESR are 05-15 mm/hr in male and 10-20 mm/hr in female. White blood cells are the principal components of the immune system and function by destroying foreign bodies such as bacteria and viruses. In the presence of an infection, the production of WBC increases. White Blood Cell
Count means the number of white blood cells in a micro-liter of blood. Normal values range from 4000/ml to 11000/ml. Differential Count (DC) of WBC determines the percentage of each type of white blood cell in a sample. D.C includes mainly neutrophils, lymphocytes and eosinophils. Neutrophils are the major players in the body's defense against bacterial infections. Normally a serious bacterial infection causes the body to produce an increased number of neutrophils, resulting in a higher than the normal white blood cell count. Neutrophil count decreases whenever there is a viral infection. The number of lymphocytes can increase in response to infections, especially by viruses or by some bacteria. Eosinophils can increase whenever there is an allergic reaction.

Normal values of DC:

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
<th>Number ( /cumm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophils</td>
<td>50 - 70%</td>
<td>3,000 - 6,000</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>20 - 40%</td>
<td>1,500 - 2,700</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>1 - 4%</td>
<td>150 - 300</td>
</tr>
<tr>
<td>Monocytes</td>
<td>2 - 8%</td>
<td>300 – 600</td>
</tr>
<tr>
<td>Basophils</td>
<td>&lt; 1%</td>
<td>10 - 100</td>
</tr>
</tbody>
</table>

The IRTIS recordings were monitored in frontal sinus areas before starting the yoga therapy for the subjects of experimental group. Similarly, the blood tests for E.S.R, T.C and D.C were done before starting the therapy. No yoga therapy was given for the control group. However the IRTIS recordings were taken and blood tests were done for the control group before starting the study.
The following yogic practices were systematically taught for the experimental group. The yoga therapy has been given according to the therapeutical method developed by Dr. K. Krishna Bhat based on Krishnamacharya-Pattabhi Jois tradition. While giving therapy, individual care has been taken and practices were taught separately to each subject for better results and precision in yoga practices. The practices were gradually taught depending on their capability and their body response to the yogic practices. The Yogic practices given include Jalaneti kriyā, Sūtraneti kriyā, Kapālabhāti kriyā, Svastikāsana, Vajrāsana, Suptavajrāsana, Simhāsana, Tadāsana I, Trikonāsana, Pārśvakonāsana, Paścimatānāsana, Pūrvatānāsana, Pavanamuktāsana, Bhujangāsana, Śalabhāsana, Dhanurāsana, Bhāradvājāsana, Ardhamatsyendrāsana, Viparītakarani, Halāsana, Uttānapādāsana, Ujjayī Prānāyāma, Anuloma-Viloma Prānāyāma, Bhastrikā Prānāyāma and Śavāsana / Yoganidrā depending on their severity and causes of the Sinusitis. The practicing procedure and photographs of the above yogic practices were given in the appendix II and appendix III respectively.

The Jalaneti kriyā has been done by using luke warm saline water. The saline water was prepared by adding salt to the boiled water (about one teaspoon to 250 ml of water) and then it was cooled up to luke warm temperature. Sūtraneti kriyā has been done by using properly prepared cotton thread. It was sterilized in boiling water before using every time. The subjects were compulsorily asked to practice kapālabhāti kriyā after neti kriyā to expel the deposited saline water particles from the mucous membrane. After the practice of kriyās, selected āsanas, prānāyāmas and śavāsana/yoganidrā were practiced in order.
All the practices were gradually introduced and taught for the first 15 days and a complete course of yoga therapy was taught for the next 15 days. Thereafter 5 months follow up was done in all the subjects. The yoga therapy has been given in the morning and subjects were asked to practice preferably in the morning during follow up period also. The IRTIS recordings were monitored at regular intervals and at the end of six months in experimental group. Similarly, the blood tests for E.S.R, T.C and D.C were done after six months in experimental group. In control group also after the duration of six months, once again the IRTIS recordings were taken and blood tests were done.

It is hypothesized that the efficacy of yoga therapy on sinusitis can be assessed by using Infra Red Thermal Imaging System and it can be used as a parameter to study the effect of yoga therapy. The null hypothesis for the present study can be framed as below.

**H\(_{01}\):** There will be no significant difference between the IRTIS thermal temperatures in ‘spot 1’ for Experimental & Control group before and after the study.

**H\(_{02}\):** There will be no significant difference between the IRTIS thermal temperatures of ‘spot 1 & spot 2 difference’ for Experimental & Control group before and after the study.

**H\(_{03}\):** There will be no significant difference between the blood tests for ESR, TC and DC of Experimental & Control group before and after the study.