

A Review of Breast Thermography

Note: The following is not a comprehensive review of the literature. Over 30 years of research compiling over 800 studies in the index-medicus exist. What follows is a pertinent sample review of the research concerning the clinical application of diagnostic infrared imaging (thermography) for use in breast cancer screening. All the citations are taken from the index-medicus peer-reviewed research literature or medical textbooks. The authors are either PhD's with their doctorate in a representative field, or physicians primarily in the specialties of oncology, radiology, gynecology, and internal medicine.

The following list is a summary of the informational text that follows:

- In 1982, the FDA approved breast thermography as an adjunctive diagnostic breast cancer screening procedure.
- Breast thermography has undergone extensive research since the late 1950's.
- Over 800 peer-reviewed studies on breast thermography exist in the index-medicus literature.
- In this database, well over 300,000 women have been included as study participants.
- The numbers of participants in many studies are very large -- 10K, 37K, 60K, 85K
- Some of these studies have followed patients up to 12 years.
- Strict standardized interpretation protocols have been established for over 15 years.
- Breast thermography has an average sensitivity and specificity of 90%.
- An abnormal thermogram is 10 times more significant as a future risk indicator for breast cancer than a first order family history of the disease .
- A persistent abnormal thermogram carries with it a 22x higher risk of future breast cancer.
- An abnormal infrared image is the single most important marker of high risk for developing breast cancer.
- Breast thermography has the ability to detect the first signs that a cancer may be forming up to 10 years before any other procedure can detect it.
- Extensive clinical trials have shown that breast thermography significantly augments the long-term survival rates of its recipients by as much as 61%.
- When used as part of a multimodal approach (clinical examination + mammography + thermography) 95% of early stage cancers will be detected.

INTRODUCTION

The first recorded use of thermobiological diagnostics can be found in the writings of Hippocrates around 480 B.C. [1]. A mud slurry spread over the patient was observed for areas that would dry first and was thought to indicate underlying organ pathology. Since this time, continued research and clinical observations proved out that certain temperatures related to the human body were indeed indicative of normal and abnormal physiologic processes. In the 1950's, military research into infrared monitoring systems for night time troop movements ushered in a new era in thermal diagnostics. The first use of diagnostic thermography came in 1957 when R. Lawson discovered that the skin temperature over a cancer of the breast was higher than that of normal tissue [2]. The Department of Health Education and Welfare released a position paper in 1972 in which the director, Thomas Tiernery, wrote, "The medical consultants indicate that thermography, in its present state of development, is beyond the experimental state as a diagnostic procedure in the following 4 areas: (1) Pathology of the female breast. (2).....". On January 29, 1982, the Food and Drug Administration published its approval and classification of thermography as an adjunctive diagnostic screening procedure for the detection of breast cancer. Since the late 1970's, numerous medical centers and independent clinics have used thermography for diagnostic purposes.

FUNDAMENTALS OF INFRARED IMAGING

Physics -- All objects with a temperature above absolute zero (-273 K) emit infrared radiation from their surface. The Stefan-Boltzmann Law defines the relation between radiated energy and temperature by stating that the total radiation emitted by an object is directly proportional to the object's area and emissivity and the fourth power of its absolute temperature. Since the emissivity of human skin is extremely high (within 1% of that of a black body), measurements of infrared radiation emitted by the skin can be converted directly into accurate temperature values.

Equipment Considerations -- Infrared rays are found in the electromagnetic spectrum within the wavelengths of 0.75 micron - 1mm. Human skin emits infrared radiation mainly in the 2 - 20 micron wavelength range, with an average maximum of 10 microns [3]. State-of-the-art infrared radiation detection systems utilize ultra-sensitive infrared cameras and sophisticated computers to detect, analyze, and produce high-resolution diagnostic images of these