COMMENTARY

Vertebral Subluxation Correction and its Affect on Thermographic Readings: A Description of the Advent of the Visi-Therm as Applied to Chiropractic Patient Assessment

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Abstract — This paper provides information first presented in 1985. The original context is presented here for its historical value, with references which confirmed the state of infrared thermography at that time. In this article, the application of infrared thermography to chiropractic analysis employed the Visi-Therm instrumentation system, developed between 1983 and 1984. Although considerable advances have been made in regard to infrared thermography, as well as the instrument system itself, the information in this article has been presented in its original context, as it marks the earliest stages, and perhaps the beginning of chiropractic use of computerized infrared thermography as a component of patient assessment. The objectives and value of this technology for monitoring the efficacy of the chiropractic adjustment given for the correction of vertebral subluxation, as well as information which distinguishes it from diagnostic therapy, are presented and discussed.

Key words: Thermogram, Visi-Therm, infrared thermography, vertebral subluxation, chiropractic, chiropractic analysis, chiropractic adjustment.

Introduction

As the spine is altered structurally, neurophysiological changes begin to take place. It is hypothesized that an effective chiropractic adjustment will produce a structural change in the vertebral segments of the spine, and that the body will express an associated neurophysiological response. This response may be manifested in a wide variety of disorders, as has been reported in conjunction with structural alterations of the spine. This paper advances the concept of thermography as a means of visualizing neurophysiological change. This provides a method whereby conclusions can be made as to the efficacy of the adjustment administered by the chiropractor.

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It has been documented, by pre and post x-ray imaging, that anatomical change to the spine does take place following chiropractic adjustments.[1-3] Relative to chiropractic, the monitoring of neurophysiological changes accompanying anatomical changes has not been reported in the literature. In that regard, clinical thermography is becoming known as a relatively inexpensive, non-invasive, accurate and safe method for establishing skin temperature differentials.[4-15] It is believed that infrared thermography may be applied as an assessment of the patient's response to the chiropractic adjustment,[4,16] and is likely to be recording neurophysiologal change.[17-20]

The use of thermography dates back at least as far as Hippocrates.[21] He observed that after smearing mud over a person's body hot areas dried fast and colder areas dried slower. He then began to correlate these areas with disease processes. While technology has changed, the same concept is applied today. Unfortunately, many instruments used in chiropractic currently employ technology of the 1800's, notably those employing thermocouples as heat detectors. This article discusses a heat detection and visualization approach which makes use of infrared sensors, microprocessors, and computer software to provide visualization of the data.

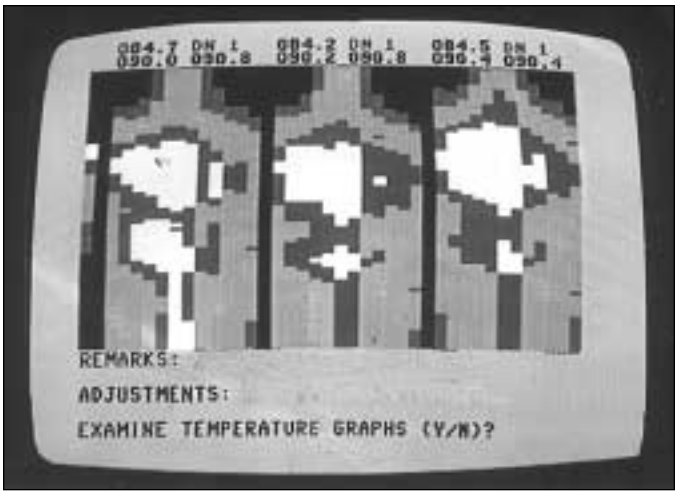

Figure 1: Three thermograms of back.

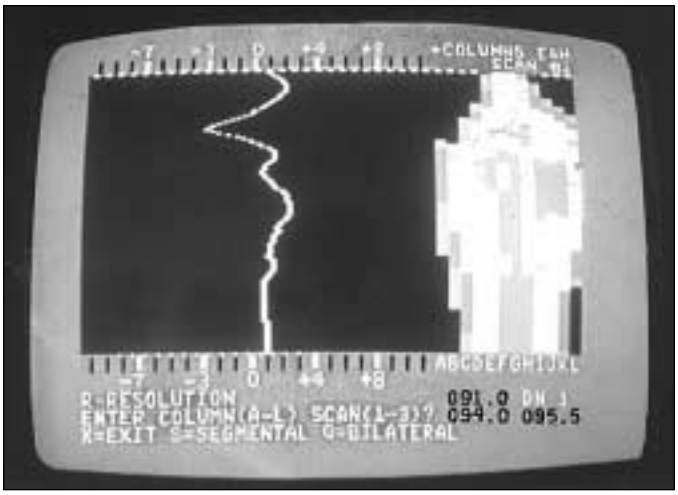

Figure 2: Bilateral temperature graph of back.

Historically, chiropractors have evaluated their patients by some means of temperature assessment. This has ranged from using the hands to detect the "hot-box," (an anatomical region of elevated temperature), to thermocouples with simple galvanometers.[22-31] The advent of thermography has now increased the chiropractic professions' appreciation for the need to measure temperature change as accurately as possible. This can be achieved through thermography. Energy in the form of infrared light is emitted by every object whose temperature is above absolute zero (- 459.7 F). This self emitted energy can be collected, transformed into electrical impulses and converted to visible light to form a heat "picture" or thermogram. A thermogram requires no external illumination or irradiation of the object, and can, therefore, be made in total darkness. Graph analysis of skin temperatures has been a form of patient assessment. It is now possible to evaluate color change as well through thermograms.

Thermography can be used to monitor temperature changes that occur at each patient visit by providing a full color display of the entire back. This non-invasive method of patient evaluation has several objectives and goals. These include (1) finding acceptable normative temperature ranges for the entire back, (2) demonstrating symmetry and asymmetry via the display of temperature (thermogram), and (3) demonstrating the relationship of previously described[32] methods of graph analysis of the paraspinal regions; primarily bilateral and segmental temperature alterations, which occur following structural change in the spine.

Instrumentation and Clinical Application of the Visi-Therm System

The Visi-Therm was developed by the authors between 1983 and 1984. It was reviewed, evaluated, and accepted by the Methods Evaluation Committee at Palmer College of Chiropractic on May 10, 1984. The Visi-Therm system has combined the technology of infrared sensors and analogue-digital conversion to produce a computer software assisted visual display of heat distribution over the entire back of the patient. The Visi-Therm system consists of a scanning paddle containing 12 primary infrared sensors and one auxiliary sensor. The electronic specifications for the system, and specific technique for carrying out the scanning procedure, are described in the patent application.[33] The 12 primary infrared sensors are used for scanning the patient's back, while the 13th sensor is used to take spot temperature readings anywhere on the body.

The scanner is connected to a computer processor by a ribbon cable. The voltages from the infrared sensors are amplified and changed to numerical data by a analogue to digital converter. Specially designed computer software processes and stores the data on floppy disks. Three full color scans can be displayed on the computer monitor at one time **(Figure 1).** Eight colors are used for display, ranging from white-dark red, light red-green, light blue-dark blue, and gray-black. White is the hottest and black is the coldest temperature. Each color covers a temperature range of 1 degree centigrade. However, the practitioner may elect to change the range for each color in 0.10 degree intervals down to a tenth of a degree centigrade.

The scanning procedure requires approximately 14 seconds, after which the color scan is displayed. This is a considerable improvement over the time required to perform a typical contact temperature scan using other methods.

Twelve segmental temperature graphs can be displayed separately for each scan. The Visi-Therm system will also display bilateral temperature graphs **(Figure 2)**. Sensors 5 and 8, while making a scan, approximate where the probes of a dual probed instrument would pass. It is, therefore, possible to display a line graph that shows the difference in contra lateral temperatures of the patient's back **(Figure 3)**. Moreover, the system also permits viewing, for the same scan, of segmental temperature graphs and pre and post adjustment scans of both segmental temperature distribution and contra lateral temperature distribution graphs. This variety of information is derived from data obtained from one, (approximate) 14 second scan of the patient's back.

Implementation and Use of the Visi-Therm

Visi-Therm is a dedicated computer system. That is, the computer will not perform other functions, nor is the scanner interchangeable with other computers. Its operation requires only that the operator activate the system and follow the displayed instructions. The Visi-Therm color logo displayed when the sys-

Figure 3: Segmental temperature graphs of back.

tem is first activated is used to make manual color adjustments. Each patient's information is stored on a separate disk. Each disk retains the equivalent of 50 office visits, or a total of 150 scans, plus an entry function that permits practitioner remarks and information on adjustments administered.

Message prompts guide the user through its protocol. For example, the user will be informed, once a disk is inserted, as to the patient's identity and what visit numbers are stored. Once a decision is made to review the disk, options are provided to (1) review previous scans, (2) take a new scan, or (3) calibrate the system. The calibration procedure is performed by directing the scanner at a standardized heat source provided with the system. Calibration is in two steps. The first step is complete when the changing numbers on the screen equals the fixed number displayed on the screen. The second and final step is achieved by pressing the return key and waiting until the numbers match the second time, at which point the return key is pushed again. This is approximately a two minute process. The need to re-calibrate depends on a variety of factors unique to each operating environment, but is generally not a frequent necessity.

If the operator selects option (1), review previous scans, it will be possible to review some or any specific previous scan. Otherwise, the operator can review all previous scans starting with the last scan taken. When the scans appear, the operator has the option to examine both temperature graphs. Change in the resolution of the color patterns is easily achieved to facilitate identification of hot and cold areas.

Selection of option (2), take a new scan; upon pressing any key, five tones will be heard one second apart, followed by a longer intermediate tone. The computer is activated to begin temperature recording the instant the intermediate tone begins. The intermediate tone is followed by six high pitched tones approximately 2.4 seconds apart. The higher tones are provided to assist the practitioner in pacing the scan. For example, when the third high pitched tone is heard, the scan should be half finished, regardless of the starting point of the scan. Thus, a short scan or a full spine scan takes the same time (14.4 seconds). The sensors do not touch the skin, and the roller assembly of the scanner contacts the back of the patient to assist the practitioner to maintain a uniform distance from the skin.

Upon completion of the scan, a full color display will appear. The system informs the user as to the location of the hottest temperature, then offers the option to record "spot" temperatures. Two spot temperatures per scan can be recorded and permanently stored for any part of the body using the 13th sensor, such as the atlas "fossa."

Following the recording of the "spot" temperatures, the examiner is given options to retake, or examine the recorded scans of up to 12 different segmental temperature readings, and one bilateral temperature graph. Resolution can also be changed in conjunction with this option.

If the option to examine the scans and graph was chosen, the system then provides up to two lines of remark entry including the practitioner's comments on such items as the date, patient's complaints, etc. Two additional lines are allowed for commentary relative to the adjustment administered.

Following completion of the commentary option, the computer is ready to take the post scan. All options that pertained to the first scan are once again offered for the post scan. Temperature graphs reviewed for the post scan can be compared to the first, or pre adjustment scan, thus facilitating comparisons of pre to post changes. Since three scans can be presented on the monitor, if the operator wishes, the pre scan can be viewed against an additional post scans, following a second adjustment.

Discussion

The information presented in this descriptive paper was intended to enhance the clinical practice of chiropractic. The purpose of the retrospective publication of this information has been to establish the historical significance of the introduction of computerized infrared thermographic analysis into chiropractic. This has been done with the intent of providing historical information for future reference and to encourage future study to advance the level of "chiropractic thermography" technology available to the profession, and to encourage its use on a broader scale.

Since changes in peripheral temperature have been associated with changes in nervous system activity, and may represent changes in other forms of visceral activity,[34-37] "chiropractic thermography" is an appropriate assessment medium for the profession. While the clinical significance of the data generated by the Visi-Therm system ultimately remains in the domain of the practitioner, the benefit of the system is that it provides reliable data for use in patient assessment before and after the chiropractic adjustment. Moreover, the data provides a documented record of changes occurring in the patient. Temperature patterns reflect physiological changes in the body, and thus contributes to objective versus subjective patient assessment. Thus, "chiropractic thermography" data reflecting physiological change, coupled to imaging studies showing structural or anatomical change, are complementary and offer the broadest spectrum of assessing patient progress.

Summary and Conclusions

A retrospective report has been provided which presents the context of a report presented before the Sixteenth Annual Biomechanics Conference of the Spine (June 20-30, 1985). The significance of this information is that it represents perhaps the

first introduction of computerized infrared "chiropractic thermography" into the area of patient assessment. This approach has been discussed in terms of its objective assessment value rather than diagnostic value to the profession. The paper has been presented to establish a starting point for the approximate thirteen years of use of infrared "chiropractic thermography" provided to the profession, and to encourage reports from field practitioners as to its current usefulness in patient assessment. Moreover, as studies published since the advent of Visi-Therm technology are linked to its concepts, it is believed that an initial reference point for the introduction of this technology to the profession is necessary to appreciate the time frame in which recent advances have been made. Over the past decade plus three years, the Visi-Therm system has been considered a safe, accurate means through which to obtain "chiropractic thermography" information for patient assessment.

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