5 Minute Thermal Pattern Analysis and Health Perception

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ABSTRACT

Introduction: Thermal pattern analysis is thought to be a health outcome for vertebral subluxation-centered practice. The theory is based on the notion that a healthy nervous system is one that is dynamic enough to allow for adequate adaptive responses to environmental challenges, and that when interference to this adaptation occurs, malfunction at some level occurs. This malfunction, although not necessarily perceptible, should be nonetheless measurable. Traditional pattern analysis consists of data obtained from different days. Some doctors however might wish to determine in a shorter time frame whether the patient is in a subluxation pattern. This study uses thermal readings taken 5 minutes apart and attempts to determine if their pattern or lack of is related to the health outcome of health perception.

Methods: Fifty-one student volunteers were scanned twice, 5 minutes apart, using a digital thermographic instrument (TyTron C-3000) on either one, two or three visits. The participants were then divided into groups according to the number of visits they achieved. The instrument produces three lines or channels: one each for the left and right sides of the spine, and a middle or delta channel, representing the difference between the two sides. A thermal pattern calculator (TPC) was used to provide a percent of similarity or pattern between the thermal scans. Participants completed the SF-12 health survey following the second scan on each visit. The survey provides composite scores for physical and mental health perceptions. The TPC percents were compared to corresponding SF-12 composite scores to see if a relationship existed between these two health outcomes.

Results: For participants’ first visit, the left channel TPC percent showed a moderate, significant, and inverse correlation with physical health perception ($r = -0.417, p = 0.002$). Also for this group, there was a significant decrease ($p = 0.04$) in physical health perception with participants having a left channel TPC percent greater than 79.5. For participants achieving three visits, their first visit showed a moderate, significant, and inverse correlation between the left channel TPC percent and physical health perception ($r = -0.400, p = 0.01$). This Group’s third visit showed a moderate, significant, and inverse correlation between the right channel TPC percent and physical health perception ($r = -0.510, p = 0.002$). The Group’s second visit showed a small, significant, and direct correlation between right channel TPC percents and physical health perception and this finding is not consistent with pattern theory. The Group’s third visit also showed a significant decrease in physical health perception in right channel TPC percents greater than 79.7 ($p = 0.03$). These findings, except for the Group’s second visit, are consistent with pattern analysis theory.

Conclusion: The majority of significant findings (five out of six) are consistent with pattern theory. The first and third visits showed significant findings consistent with pattern analysis theory. In particular, participants having a left channel TPC percent of 79.5 percent or greater, or a right channel TPC percent of 79.7 or greater, experienced decreased physical health perception. These findings may serve as the beginning of establishing protocols for obtaining thermal readings as well as guidelines for their interpretation.

Key Words: Thermal pattern analysis, chiropractic, SF-12, health perception

Introduction

Skin temperature is primarily under the control of the autonomic nervous system and can be used as an assessment of autonomic function. Thermal pattern analysis is a method that purportedly assesses autonomic function thought to be associated with vertebral subluxation. Thermal pattern analysis theory is based on the concept that dynamic skin temperature differentials reflect a nervous system that is adaptive, and therefore healthy. A high TPC percent would reflect a high amount of pattern and would be considered to

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represent a nervous system that is not optimally adaptive, and therefore unhealthy. The method has been in use since the 1940s. More recently, thermal pattern analysis has been used in case studies as well as in a study on thermal equilibration. However, the relationship of thermal patterns and health outcomes has not been adequately explored. The hypothesis of this study is that high TPC percents are associated with low health perceptions and vice versa.

Typically, thermal pattern analysis is done with readings taken from different days and is based on the assumption that because of the many intervening events (challenges) from one day to the next, there should be sufficient challenge to a person to the extent that there nervous system would be expected to change (from one day to the next). This change in turn would, in theory, be noticeable with tests that assess neurophysiology, i.e., with thermographic pattern analysis. Some practitioners however, may wish to obtain a decision as to whether the patient is subluxated in a shorter period of time. In this regard, the present study uses readings taken 5 minutes apart, from the same visit.

Although the time interval is small, it was hypothesized that room temperature, which is typically around 20 degrees F cooler than skin temperature, would offer a sufficient environmental (thermal) challenge to a gowned person when his or her back is exposed. As with challenges from day-to-day, this thermal challenge in a 5 minute period would, in theory, allow recognition of persons having greater versus lesser adaptive response (under the control of a healthy, dynamic nervous system) to the thermal challenge.

Current technology allows temperature differentials obtained through infra-red scanning to be quantified with the use of the thermal pattern calculator (TPC) software. The TPC software permits scanned temperatures to be compared for percent similarity of slope (TPC percent). In this way, thermal pattern analysis is quantifiable and therefore more objective.

Methods

The study was approved by the Sherman College IRB. Fifty-one volunteers (24 females, 27 males between the ages of 21 and 56) volunteered to be scanned with the TyTron C-3000 (Titronics R & D, Oxford, IA). Fifty-one of the participants presented for one visit, 43 of the 51 presented for a second visit while 34 of the 51 presented for three visits. All visits were 1 week apart. The participants were analyzed according to the visits they achieved, as follows: Group 1 = first visit (n = 51), Group 2 = the second visit (n = 43), Group 3 = those having all three visits, and are subdivided as follows: Group 3a = first visit (n = 34), Group 3b = second visit (n = 34), Group 3c = third visit (n = 34), and Group 3d = combination of 3a, 3b, and 3c (n = 102).

The thermal scans commenced at the L5 level and continued to the occipital shelf. Each participant was positioned in a posture constant chair for the scanning procedure as described elsewhere. Two thermal scans were taken on each visit, 5 minutes apart. The initial scan was taken approximately 1 minute after each given participant’s back was exposed to an ambient room temperature of 70-75 degrees F (referred to as the 1 minute reading). The second scan was taken five minutes later (referred to as the 6 minute reading). Each scan produced three lines, or channels. The left channel represents the left side of the spine, the right channel represents the right side of the spine, and a third center channel represents the difference (delta) between the left and right channels. The TyTron scanning procedure has been found to be reliable.

SF-12

Following the thermal scans, each participant completed the SF-12 health survey (v. 2, 1 week recall). The SF-12 was used to assess participants’ health perceptions. The survey instrument contains 12 questions and a Physical Composite Score (PCS) and Mental Composite Score (MCS). The composite scores (PCS and MCS) are reported in the present study. The survey asks the respondent questions about general health, physical limitations, energy levels, and emotional status. The higher the SF-12 score, the better the health perception and vice versa. Consequently, according to pattern theory, there would be an inverse relationship between TPC percent and health perception. That is, decreased health perception would be expected to correspond to high TPC percents and increased health perception would be expected to correspond with low TPC percents.

Because the TPC percents would be compared to the SF-12 responses, the operator of the TPC was blinded to the SF-12 responses at the time the TPC calculations were conducted. Each TPC percent involved a comparison of two thermal scans. The thermal scans (left and right channels) were imported to the TPC software program which determines percent similarity of slope between two scans (Figs.3-4). The TPC procedures have been found to be reliable and its details have been described elsewhere.

Analysis of Data

According to the Kolmogorov-Smirnov and Shapiro-Wilk tests, the data were not normally distributed. Consequently, the non-parametric statistics Spearman (for correlation) and Wilcoxon (for differences) were used. The level of significance used was the two-tailed p-value of < 0.05. The statistical tests were performed in the Statistical Package for the Social Sciences (SPSS, Chicago, IL, Version 14.0) while the SF-12 was scored in a spreadsheet.

Data were analyzed for correlation and differences. Correlation was assessed between TPC percents and SF-12 scores. Differences were assessed between SF-12 scores corresponding to participants having high TPC percents and SF-12 scores corresponding to participants having low TPC percents. These differences were assessed by arranging the thermal channels in a list from highest-to-lowest TPC percents, along with corresponding SF-12 scores, and then dividing the list in half. For Group 1, the list consisted of the highest 25 TPC percents and corresponding SF-12 scores compared to the lowest 26 TPC percents and corresponding SF-12 scores. For Group 2, there were 21 high and 22 low TPC percents along with corresponding SF-12 scores. For Group 3 sub-groups (3a, 3b, and 3c) there were 17 in the high and 17 in the low TPC percent groups for each of these.
sub-groups. For Group 3d (all three of these visits combined for those achieving three visits), there were 51 in the upper TPC percent sub-group along with corresponding SF-12 scores and 51 participant visits in the lower TPC percent sub-group along with corresponding SF-12 scores. Only findings which were significant are reported in the Results section.

Results

Group 1 (participants having at least an initial visit, n = 51)

For the left channel, there was a moderate, significant, and inverse correlation of TPC percents and physical composite scores ($r = -0.417, p = 0.002$) (Figure 1, Table 1). There was also a significant decrease in physical health perception in participants having a left channel TPC percent of 79.5 percent and greater ($p = 0.04$, Table 2). These findings are consistent with pattern theory.

Group 2 (second visit, n = 43)

There was a small, significant, and direct correlation between the right channel TPC percents and physical health perception ($r = 0.324, p = 0.03$, Table 1), and this is not consistent with pattern theory.

Group 3 (participants presenting for three visits, n = 34 each visit)

For the first visit (Group 3a), there was a moderate, significant, and inverse correlation seen between the left channel and physical health perception ($r = -0.400, p = 0.01$, Table 1). In the third visit (Group 3c), there was a moderate, significant, and inverse correlation between the right channel and physical health perception ($r = -0.510, p = 0.002$, Table 2). Also in the right channel for Group 3c, there was a significant decrease ($p = 0.03$) in physical health perception for those participants having a TPC percent of 79.7 percent and greater (Table 2). These findings are consistent with pattern theory.

Discussion

Limitations of the Study

Although the participants represent a random sample from the classes where they volunteered from (they all had an opportunity to participate), they may not be representative of the population at-large. However, given the wide variation of TPC percents, it is believed that there is a similarity between this student population and the general public. Furthermore, it is not uncommon for healthy volunteers to be used in clinical studies. For example, each year approximately 3,500 healthy volunteers participate in clinical studies through the National Institutes of Health.14

Another potential limitation of this study is the use of multiple tests for significance. Some call for a Bonferroni correction while others claim that this is not necessary, that interpretation can be left up to the reader.15 The latter position is taken in this paper. When the use of Bonferroni adjustment is questionable, significant findings should be verified in a follow-up study.16 With the Bonferroni adjustment, where the traditional alpha level (0.05) is divided by the number of tests done (12), the Bonferroni correction lowers the alpha to 0.0041 for each Group. With this more stringent alpha level, the correlations in Groups 1 and 3c (Table 1) remained significant with their respective $p$ value of 0.002.

Of the six significant findings in this study (Tables 2 and 3), five were consistent with pattern theory (Group 2, Table 2). Consequently, the preponderance of significant findings in this study supports the theory of pattern analysis. It is not known why the delta channel failed to exhibit significant findings. Perhaps the reason pertains to the delta channel being a secondary calculation, and therefore not as direct of a measurement of neurophysiology as the right and left channels. Another mystery is why the second visit showed findings opposite of pattern theory while the first and the third visits showed findings consistent with pattern theory. This may suggest that visits using the protocol (1 minute and 6 minute acclimated readings from the same visit) should be scheduled two weeks apart rather than one week apart.

It is not surprising that readings taken only minutes apart (5 minutes apart in this study) would be different. Room temperature is cooler than skin temperature and this challenge to the body is bound to change the readings, as a previous study showed.8 This thermal challenge is useful for determining, in the short term (i.e., within 5 minutes), whether the patient is in a subluxation pattern. Further research is needed, preferably with greater participant numbers, to verify these findings. Future study will study the more traditional protocol by comparing the initial (1-minute acclimated readings) and second (6-minute acclimated readings) from different days.

Pattern Theory

Adaptability is an important aspect of good health while decreased adaptability is thought to be related to decreased health.17-19 A healthy heart for example, is said to exhibit a variable rate of beats, even while resting.20 Similarly, Varela et al note that persistent temperature findings signal an unhealthy prognosis.21 Likewise, Lipsitz notes that:

Under basal resting conditions most healthy physiologic systems demonstrate highly irregular, complex dynamics that represent interacting regulatory processes operating over multiple time scales. These processes prime the organism for an adaptive response, making it ready and able to react to sudden physiologic stresses. When the organism is perturbed or deviates from a given set of boundary conditions, most physiologic systems evoke closed-loop responses that operate over relatively short periods of time to restore the organism to equilibrium. This transiently alters the dynamics to a less complex, dominant response mode, which is denoted "reactive tuning." Aging and disease are associated with a loss of complexity in resting dynamics and maladaptive responses to perturbations. These alterations in the dynamics of physiologic systems lead to functional decline and frailty. Nonlinear mathematical techniques that quantify physiologic dynamics may predict the onset of frailty, and interventions aimed toward restoring healthy dynamics may prevent functional decline.17
The author believes that assessment of whether autonomic function is dynamic or not (i.e., with the use of thermal pattern analysis) is one possible method of assessing, albeit indirect, of what Stephenson referred to as mental impulse. Consequently, thermal pattern analysis may be one method, albeit an indirect method, of mental impulse assessment.

Implications

There were significant findings in Groups 1, 3a and 3c. The question that invariably arises is at what percent does the pattern become significant? The left channel in Group 1 and the right channel in Group 3c both exhibited a similar “threshold” percentage (of 79.5 and 79.7 respectively), above which decreased physical health perception occurred (Table 3). The finding in Group 1 (the left channel) could be viewed as stronger than found in Group 3c (the right channel) because of the increased number of participants (51 versus 34). However, the stronger correlation coefficient seen in the latter versus the former (-0.510 versus -0.417) could offset the advantage of the greater number of participants. Consequently, the left and right channels appear to have equal weight of evidence.

These findings could provide a beginning for the establishment of protocols and guidelines for thermal pattern analysis based on the health outcome of health perception. The protocols involve obtaining readings after 1 minute of acclimation and then another reading 5 minutes later (1 minute and 5 minute readings). The guidelines involve interpretation – in this case of the left channel having a threshold percent of 79.5 and greater associated with decreased physical health perception. The right channel would involve the same protocol along with the threshold guideline of 79.7. These guidelines are supported by their respective moderate correlations with physical health perception (Table 2).

Conclusions

In this study, participants having a left channel TPC percent of 79.5 percent or greater, or a right channel TPC percent of 79.7 or greater, tended to have lower physical health perceptions. Further research is warranted to confirm the findings, as well as to determine if similar findings exist using the traditional protocol of performing pattern analysis on readings obtained from different days.

References

Figure 1. Correlation of left channel TPC percents and physical composite scores for Group 1. ¹

1. Group 1 = first visit (n = 51). The data shows a moderate, significant, and inverse correlation between left channel TPC percents and physical composite scores (r = -0.417, p = 0.04). Computer-generated trend line is added to each of the variables (left and PCS) and show that as the left channel TPC percents (upper line) decreases (= improved adaptability), the physical composite score (PCS) increases (also viewed as an improvement).
### Table 1
Significant Correlations

<table>
<thead>
<tr>
<th>Group / n</th>
<th>Channel / TPC percent range</th>
<th>Corresponding SF-12</th>
<th>Correlation coefficient / P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 / 51</td>
<td>Left / 55.1 – 92.8</td>
<td>PCS</td>
<td>-0.417 / 0.002</td>
</tr>
<tr>
<td>2 / 43</td>
<td>Right / 60.7 – 96.1</td>
<td>PCS</td>
<td>0.324 / 0.03</td>
</tr>
<tr>
<td>3a / 34</td>
<td>Left / 55.1 – 90.5</td>
<td>PCS</td>
<td>-0.400 / 0.01</td>
</tr>
<tr>
<td>3c / 34</td>
<td>Right / 63.0 – 95.6</td>
<td>PCS</td>
<td>-0.510 / 0.002</td>
</tr>
</tbody>
</table>

1. Thermal scans taken 5 minutes apart. Each scan produces three lines; one each for the left and right sides of the spine and a delta line representing the difference between the two sides. Group 1 = all participants having at least an initial visit. Group 2 = second visit. Group 3a = first visit from participants having three visits, 3c = third visit from participants having three visits. PCS = physical composite score. All correlations except that from Group 2 are consistent with pattern theory.

### Table 2
Significant Differences

<table>
<thead>
<tr>
<th>Group</th>
<th>Channel</th>
<th># in upper / lower TPC% group</th>
<th>Upper TPC% range</th>
<th>Lower TPC% range</th>
<th>Corresponding SF-12</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left</td>
<td>25 / 26</td>
<td>79.5 – 92.8</td>
<td>55.1 – 79.1</td>
<td>PCS</td>
<td>0.04</td>
</tr>
<tr>
<td>3c</td>
<td>Right</td>
<td>17 / 17</td>
<td>79.7 – 95.6</td>
<td>63.0 – 77.4</td>
<td>PCS</td>
<td>0.03</td>
</tr>
</tbody>
</table>

1. Thermal scans taken 5 minutes apart. Each scan produces three lines; one each for the left and right sides of the spine and a delta line representing the difference between the two sides. Group 1 = all participants having at least an initial visit. Group 3c = third visit from participants having three visits. PCS = physical composite score. These findings are consistent with pattern theory.