Standard deviation analysis of the mastoid fossa temperature differential reading: a potential model for objective chiropractic assessment

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Abstract

Objective: This study describes a model for statistically analyzing follow-up numeric-based chiropractic spinal assessments for an individual patient based on his or her own baseline.

Methods: Ten mastoid fossa temperature differential readings (MFTD) obtained from a chiropractic patient were used in the study. The first eight readings served as baseline and were compared to post-adjustment readings.

Results: One of the two post-adjustment MFTD readings fell outside two standard deviations of the baseline mean and therefore theoretically represents improvement according to pattern analysis theory.

Conclusion: This study showed how standard deviation analysis may be used to identify future outliers for an individual patient based on his or her own baseline data.

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Introduction

A potential weakness in health care is the subjectivity that accompanies interpretation of clinical assessments. Clinical uncertainty on the part of the practitioner¹ is a condition that the practitioner learns to cope with when attempting to decide whether a clinical finding is significant or not. For example, it may be difficult to ascertain whether a core temperature

of 99.0 should be cause for alarm in a person whose average core temperature is 98.8 degrees Fahrenheit.

Statistical tests typically are used to compare data between groups, or using group data to assess another individual patient. Before and after (paired) data analysis is also common but even this typically involves multiple patients. What seems to be missing is having the individual patient be his or her own control, comparing a future clinical observation to his or her own prior abnormal baseline. The present report highlights the feasibility of comparing a baseline of measurements that are thought to represent an abnormal condition, to individual follow-up measurements for the same patient using the standard deviation

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statistic. Although many assessments in chiropractic do not lend themselves to continuous, measurement type numerical data analysis, there are some assessments that do provide such an opportunity. One such assessment is the mastoid fossa temperature differential reading (MFTD). MFTD analysis has been in use in chiropractic since the 1950s^{2,3} and continues to be discussed in more recent literature.⁴⁻⁹ The reading is obtained by taking a temperature measurement in the mastoid fossa area without making contact (region behind the ear; Fig 1). The MFTD reading is calculated by subtracting the mastoid fossa temperature reading on one side from the other side. For example, a patient with a mastoid fossa reading of 95.0 degrees Fahrenheit on the left side and 95.2 degrees on the right side would have an MFTD reading of 0.2 degrees warmth on the right side. It is also possible that the temperature is the same on both sides, thereby resulting in an MFTD of 0.0. The clinical significance of the MFTD readings has yet to be determined. One method for interpreting MFTD readings is with pattern analysis, where an abnormal set of baseline readings are identified and thought to be related to the condition known as vertebral subluxation.^{5,7,8}

Reliability of MFTD analysis has been studied with varied results.^{6,9} The author was part of a reliability study of MFTD analysis using the instrument used in the present report and his intra-examiner reliability was shown to be high while poor reliability was revealed for the other two examiners in this study.⁹ Interestingly, *inter-examiner* reliability was good for these three examiners.⁹ Although the instrument has FDA approval as a temperature measuring device by a chiropractor (FDA registration #K974208O, the

Fig 1. Obtaining a temperature measurement in the mastoid fossa.

validity of the MFTD procedure has yet to be adequately demonstrated).

In this descriptive report, a novel method of analyzing MFTD readings using a standard deviation (SD) test for estimating future outliers based on the individual patients small sample baseline measurements is suggested. The focus of this report is on the use of SD analysis for estimating future outliers for the purpose of applying SD as a potential method of assisting the chiropractor in performing an objective assessment of numerical data for the individual patient based on his or her own baseline data.

Methods

The study was approved by the Institutional Review Board at Sherman College of Chiropractic on May 21, 2010. The MFTD readings were taken with an infrared thermographic instrument manufactured by Titronics Research and Development (Tiffin, IA). The instrument automatically calculates the differential and records the MFTD in Celsius with two decimal places. For example, a recording of “0.21 L” would indicate that the fossa on the left side is warmer by 0.21 degrees Celsius. Ten consecutive MFTD readings taken by the author on a 42 year old female asymptomatic maintenance type care patient were used for this study. The study period was from 8-11-09 to 10-1-09. During this time, the patient received one chiropractic adjustment, on 9-15-09.

The first eight readings in this series, taken before the adjustment on 9-15-09, are referred to here as “baseline readings” (Fig 1) and are considered to represent an abnormal condition (of less-than-dynamic neurophysiology^{7,8}). A chiropractic adjustment was delivered on 9-15-09 following these eight baseline readings. A post-adjustment MFTD reading was taken the day after the adjustment (9-16-09) and a second post-adjustment MFTD reading was taken approximately two weeks after this (10-1-09).

Readings outside a pre-determined level of standard deviation (two SD in this case) would be considered as outliers and therefore significantly different from the baseline. Follow-up MFTD readings that are statistically different from baseline (outside two SD in this case) would be considered as improved while readings within the interval would be considered as not improved compared to the abnormal baseline. Analysis was performed in Excel (Microsoft Corp., Redmond, WA). MFTDs warmer on the left side were given a negative sign while MFTDs warmer on the right side remained entered as a positive value.

Results

The mean for the eight baseline readings was -0.27 (left-sided heat) ± 0.18 . The interval using two SD = -0.63 (left-sided heat) to 0.08 (right-sided heat). The first post-adjustment MFTD reading (9-16-09), 0.23 (right-sided heat) fell outside the two SD interval while the second post-adjustment MFTD reading (10-1-09) did not (Fig 2).

Discussion

In this report, the use of two SD revealed that the first post-adjustment MFTD reading is an outlier and therefore considered significantly different (statistically speaking) from the abnormal baseline. Since this MFTD reading was taken the day after the adjustment, it is assumed that any effect on fossa temperature from the adjustment contact by the doctor subsided by the time this reading was taken. Assuming the baseline represents an abnormal condition, the adjustment appears to be related to this outlier. It is not known whether the baseline actually represents an abnormal condition. If future outcomes research indicates that such a baseline actually represents a normal, healthy condition, then an opposite conclusion would be reached, where the outlier on 9-16-09 would accordingly indicate that the adjustment given on 9-15-09 may have done more harm than good. Future outcomes research will help to indicate which method, if either, is more valid. The evidence for MFTD in any of its interpretation as being a valid indicator for chiropractic adjustment is specu-

lative at this point. Future research could also disclose what level of SD should be used (one, two, or three) and this may be test-dependent, that is, some tests might require one SD while others require three.

The application of SD analysis in this report has more similarities with traditional pattern analysis interpretation rather than the symmetry model of interpretation. Both methods of interpretation (SD and pattern analysis) view change from baseline as improvement while same-ness would be considered as non-improvement.⁸ In the pattern analysis model, most of the baseline readings showed a preponderance of readings showing warmer mastoid fossa on the left side, hence a pattern of left-sided warm fossa.

SD analysis as used in this report may help to identify future outliers when comparing to baseline measurements for a specific patient. Other chiropractic assessments that provide numeric data, such as thermal pattern analysis of full spine temperature readings,⁷ would also seem to benefit from the objectivity provided by SD analysis for assessing new (subsequent) readings.

It is hoped that the analysis as described in this report may assist the chiropractor using MFTD or similar assessment (that uses continuous data in its output, such as a portable thermometer¹⁰) in deciding whether a follow-up finding for a specific patient is significantly different (statistically speaking) from his or her baseline that is thought to represent an abnormal condition. This in turn would seem to help the chiropractor, in an objective way, to determine whether the finding indicates that an intervention such as a chiropractic adjustment is needed.

Limitations

Limitations to this report include the following. There may have been examiner variation in obtaining MFTD data. The findings of this study do not imply clinical significance of changes of MFTD since that would need to be addressed in a different study. Statistical significance does not guarantee that a practical difference exists. Future outcomes research is required to address questions of clinical significance of the MFTD readings and the different standard deviation levels.

Conclusion

The use of standard deviation analysis, as described in this report, is an example of how before and after

Fig 2. Chart for two standard deviations for analysis of MFTD outliers. First eight readings are baseline (mean = -0.27 ± 0.18). Vertical line separated the eight pre-adjustment readings from the two post-adjustment readings, one of which fell outside of two standard deviations of the mean of the eight baseline readings (upper and lower limits represented by uppermost and lower-most horizontal lines).

data from a given patient can be statistically compared in an attempt to determine if there are changes in outcome measures. Outcomes research is needed to determine whether the method has clinical significance.

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