Comparison of Oral and Tympanic Temperatures in Adult Surgical Patients

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Monitoring patients’ temperatures is an important aspect of clinical nursing. In surgical areas, we rely on accurate temperature readings to determine appropriate therapy. Various body sites have been used for temperature measurement: oral, axillary, rectal, and tympanic. Oral temperature readings have long been considered the gold standard. However, oral temperature readings may be contraindicated, depending on surgical incision and level of consciousness or in cases of seizure. Tympanic temperature monitoring is often the next choice. The literature supports the accuracy of tympanic monitoring; however, some clinicians have questioned its accuracy. This study used a repeated-measures design to determine the reproducibility of tympanic and oral temperature measurements. A difference of 0.2°C was considered clinically significant. Outcome data indicated that variability was similar with oral and tympanic temperatures. There was no significant difference between average tympanic and average oral temperatures. Therefore, this study supports the use of tympanic thermometers in addition to oral thermometers in obtaining temperatures.

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Oral thermometers have long been considered the gold standard for obtaining temperatures. However, oral temperatures can be affected by the ingestion of hot or cold substances (Beck & Campbell, 1975), and it has been suggested that smoking and mouth breathing can cause clinically significant changes in oral temperature. In addition, oral temperature readings may be contraindicated depending on surgical incision and level of consciousness or in cases of seizure.

The infrared tympanic thermometer is placed in the ear canal to measure tympanic membrane temperature. It has been proposed that tympanic temperature monitoring more closely correlates with core temperature than oral temperature (Shiraki, Konda, & Sagawa, 1986; Shinozaki, Deane, & Perkins, 1988). This relationship is caused by the proximity of the tympanic membrane to the hypothalamus and common blood flow from the internal carotid to the tympanic membrane and hypothalamus. However, because the external carotid arteries provide the blood flow to the tympanic membrane, ambient temperature may have a greater effect on aural temperature than on core temperature (Brengelmann, 1993). With both oral and tympanic methods of temperature measurements, clinician technique in performing the skill can significantly affect the outcome.

Much of the research on temperature measurement has focused on the reliability and validity of various thermometers and, more specifically, the extent to which thermometers approximate core temperature. Irvin (1999) studied the difference between oral and tympanic thermometers and found a significant difference between the two. However, the difference was not clinically significant. In addition, there was wide variability in both oral and tympanic thermometer readings. An unexpected finding was that 58% of the oral temperature readings were 1°C higher than tympanic readings, in contrast to other research, which found that tympanic thermometers yielded higher readings than oral thermometers (Erickson & Yount, 1992). Erickson and Yount’s study of 60 adult surgical patients supported the use of either oral or tympanic thermometers. Other studies also supported both these methods of temperature measurement (Summers, 1991; Talo, Macknin, & Medendorp, 1991). However, clinicians continue to question the accuracy of tympanic thermometers. This study therefore was proposed to further examine the concordance of tympanic and oral temperature readings.

**METHOD**

**Design and Sample**

A repeated-measures design was used to determine the reproducibility of tympanic and oral temperature measurements. The study was conducted on three surgical units at a tertiary-care center.

Patients were included in the study unless they met any of the following exclusion criteria: younger than 18 years of age, documented history of carotid disease, ear canal and/or mouth abnormalities, or altered mental status. Clinical measurements of temperatures were those currently used; therefore, informed consent was not required.

**Data Collection**

One designated First Temp Genius and one IVAC thermometer were used for data collection. Before collection of data, the clinical engineering department of the hospital calibrated the thermometers. The First Temp Genius was programmed in the Core Mode, which is the setting on the thermometer that reflects core temperature and does not calculate an oral or rectal equivalent. Cleaning the lens on the First Temp Genius was performed daily, as recommended by the manufacturer.

Temperatures (oral and tympanic) were obtained on a sample of 257 adult surgical patients based on the standard vital sign times of the units involved. The patient was asked whether he or she had ingested any hot or cold food and/or liquid within 15 minutes of obtaining the temperature. The data collector obtained a tympanic and an oral temperature, then the patient’s primary nurse or nursing assistant performed repeat temperature measurements. The staff member was asked to leave the
room during the data collector’s temperature measurements. The staff’s technique was observed during the measurement. Tympanic temperatures were measured first and taken in the same ear. If the patient was lying on an ear, the tympanic temperature was taken in the opposite ear. Oral temperatures were taken within 2 minutes of tympanic temperatures. These data were recorded on a data collection sheet.

Three data collectors were trained by representatives of the First Temp Genius Company, which markets the tympanic thermometer used in the study. The three investigators reviewed correct temperature-measuring techniques for the IVAC as defined by the operating manual. The correct procedure included inserting the probe tip in the sublingual pocket, holding the probe during the entire temperature measurement process, and keeping the probe tip in contact with tissue at all times. Three investigators then sequentially measured oral and tympanic temperatures on 20 patients to ensure interrater reliability using the designated calibrated thermometers. These data were recorded on the data collection sheet.

RESULTS

Statistical significance was set at \( p \) less than .05. Clinical significance was considered to be a difference of ±0.2°F. Data from the 257 patients resulted in 514 paired tympanic temperature measurements and 514 paired oral temperature measurements. Mean absolute difference in \( t_1 \) and \( t_2 \) tympanic temperatures was 0.28°C, and 46% of differences between the paired measurements were clinically significant (≥ ±0.2), illustrated in Figure 1. The mean absolute difference between \( t_1 \) and \( t_2 \) oral temperatures was 0.19°C, and 63% of differ
Figure 2. Differences in oral temperature measurements.

Figure 3. Differences between tympanic and oral temperature measurements.
ences between them were clinically significant (Figure 2). The mean absolute difference between mean tympanic and mean oral temperatures was 0.36°C, and 34% of differences were clinically significant.

Correlations between the first tympanic measurement and the tympanic difference score \((r = -0.40, p < .001)\) and between the first oral measurement and the oral difference score \((r = -0.42, p < .001)\) were similar. The paired t-test between the average tympanic and average oral measures was not significant \((t = 0.03, p = 0.97)\). Differences between tympanic and oral measures were strongly negatively correlated \((r = -0.96, p < .001)\), illustrated in Figure 3. At lower temperatures, tympanic temperatures were higher than oral temperatures, whereas at higher body temperatures, oral temperatures were higher. This finding merits further investigation.

Data on technique errors also were collected during the study period. For oral temperature, the technique errors noted were not asking patient about intake, 95.71%; did not hold the probe, 66.09%; patient not closing mouth around probe, 3.00%; improper placement, 1.72%; and an improper seal, 0.43%. For tympanic temperatures, technique errors noted were failure to inspect lens, 99.57%; reaching/using opposite ear, 9.44%; improper seal, 2.15%; and failure to attach cover properly, 0.43%.

**DISCUSSION**

Unlike Irvin’s (1999) and Erickson and Yount’s (1992) studies, no statistically significant differences between tympanic and oral temperature measurements were found. This study provides additional evidence of the accuracy of tympanic measurements.

One of the most important conclusions drawn from this study is that temperature is a dynamic parameter; therefore, treatment must be directed at the entire clinical presentation, not just on a single measurement. Because there was no correlation between tympanic and oral temperatures, the clinician cannot infer a relationship between two temperature modes. This supports using the same type of thermometer if serial temperatures are to be taken. Treatment protocols for abnormal temperatures may be indicated and include a series of temperature measurements before treatment is initiated.

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**REFERENCES**


