

The Difference of Tympanic Temperature According to Insertion Methods of Tympanic Thermometer Probe

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Abstract. This study was conducted from March 2015 to June 2015 on 185 adults to examine the difference according to the insertion methods of thermometer probe when measuring the tympanic temperatures. Three kinds of measurement method were significantly different in their temperatures depending on gender or on participants' reaction to comfortableness. However, since the difference is within a small error range of 0.1 °C or less, which is less than a margin of error that happens when measuring body temperature, it only has statistical difference and no clinical meaning. Therefore, although it is stated in textbooks that when measuring the tympanic temperature of an adult, it is the most accurate to measure with the upward and back pulling of an ear, it seems like there will be no substantial difference if they measure in a way that participants feel the most comfortable.

Keywords: Tympanic temperature, Measurement method

1 Introduction

Accurate temperature measurement is important in the evaluation of a patient's health status because temperature is an important clue to assess the patient's condition as one of the vital signs. There are two types of temperature measurement: invasive and non-invasive method. Invasive method can be measured from pulmonary artery, esophagus, and urinary bladder, and reflects the core temperature well, however, because of its specific clinical procedure and a higher risk of infection, non-invasive method is used in clinical. The use of mercury, one of non-invasive temperature measurement methods, is prohibited in hospitals since 2015 for safety reasons, and instead, detecting infrared emitted from the body to measure the tympanic membrane temperature is widely used to measure the body temperature. Tympanic temperature reflects the core temperature well and the measurement time is short and simple[1]. The results may differ depending on the measurement method and measuring persons because the probe of the thermometer must detect infrared rays emitted from the eardrum[2,3]. Therefore, theoretically, in order to measure the temperature, for an adult, one must pull the ear upward and then back, and for a child, one must pull the ear downward and back so that external auditory meatus is in a straight line in a way

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that the probe of the thermometer is in the direction of the eardrum[4]. However, many nurses in actual clinical practice tend to skip the ear-pulling part or measure the tympanic membrane temperature in different ways. Therefore, it is necessary to examine the variance when measuring the tympanic membrane temperature in different manners, and to analyze whether the margin of error of the body temperature with and without the pulling of ear is within the range of $\pm 0.2^{\circ}\text{C}$ [5]. Most of the studies done until now are based on the assumption of having external auditory meatus in a straight line, and research methods were based on the comparisons of the different temperature measurement methods [3,6-9]. There was no study discussing how the result may vary depending on the way of a probe inserted in the eardrum. Therefore, the purpose of this study is to examine the meaning of any variance resulting from three main methods of inserting a probe when measuring the tympanic temperature and to find the most comfortable method for participants when measuring temperature in order to establish evidence-based practice.

2 Method

This study was conducted an exploratory survey on 185 healthy adults who have no ear disease or fever and measured their tympanic temperature with their permission. Research methods were first examined using a questionnaire on the basic information and measured tympanic temperature with a Brown tympanic thermometer twice for each method and calculated the average. First, it was measured twice after pulling the pinna upward and back, and measured twice after pulling downward and back. Then it was measured twice without pulling of the ear. After measuring twice for each, we examined the most comfortable way to measure temperature for participants. Repeated measure ANOVA was done to compare the three methods using SPSS 19.0.

Ethical approval for this study was obtained from the Institutional Review Board of the Semyung University(approval no. SMU-2014-03-001).

3 Results

3.1 General Characteristics

Among the 185 participants, women were 56.8 % (105), and men were 43.2% (75). The average age was 41. Participants who had no experience of temperature measurement were 23.2%, and among those who had the experience, 69.4% experienced tympanic temperature measurements, 16% axillary measurements, and 14.6% either oral or temporal artery measurements.

3.2 Comparison of Tympanic Temperature According to the Different Probe Insertion Methods

Tympanic temperature when inserted the probe of the tympanic thermometer with pulling the pinna upward and back was $36.8 \pm 0.29^{\circ}\text{C}$, $36.7 \pm 0.31^{\circ}\text{C}$ when pulled downward and back, and $36.7 \pm 0.28^{\circ}\text{C}$ when there was no pulling. Pulling the pinna upward and back resulted in 0.1°C higher than measured with other two methods. When compared the difference in temperatures due to different measurement methods, the difference was significant ($p < .001$), and because of the interaction between gender and the direction of probe inserted ($p < .001$), the measured tympanic temperatures varied depending on the direction of insertion and on gender.

3.3 Comparison of Tympanic Temperature Measurement felt comfortable

Most participants, about 40%, felt comfortable with probe inserted without pulling of the ear, 35.1% felt comfortable with probe inserted when their ears were pulled upward and back, and 24.9% felt comfortable when their ears were pulled downward and back. Comparing the difference of the measurements done by how participants have felt when the probe was inserted, the temperatures were significantly different depending on the measuring direction ($p < .001$), and due to the interaction between the methods that participants have felt comfortable and the measured values ($p < .001$), the tympanic temperature varied depending on the direction of insertion and on the methods participants have felt comfortable.

4 Discussion

Infrared tympanic membrane thermometers are considered ideal because the tympanic membrane and the hypothalamus share an arterial blood supply originating from the carotid artery, and the tympanic membrane is considered to directly reflect core temperature[9]. Nurses have been learned to insert the probe of the infrared thermometer into the external auditory meatus by pulling the pinna upward and back for right measurement of adults. However, the result of this research showed that there were no clinical differences among three methods to insert the thermometer probe into the ear despite of the statistical differences.

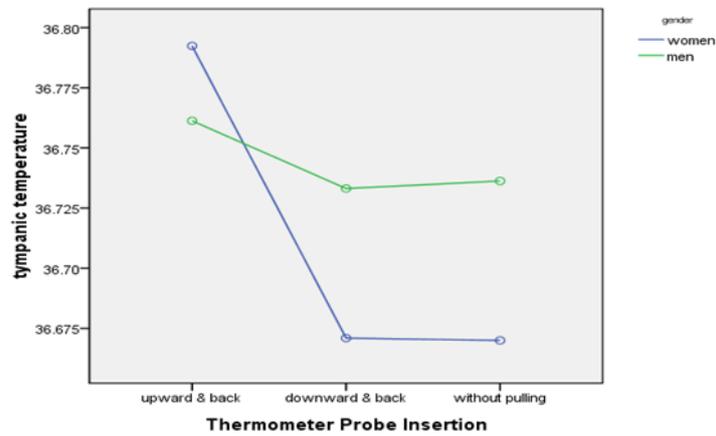


Fig. 1. Tympanic Temperature According to the Thermometer Probe Insertion & Gender

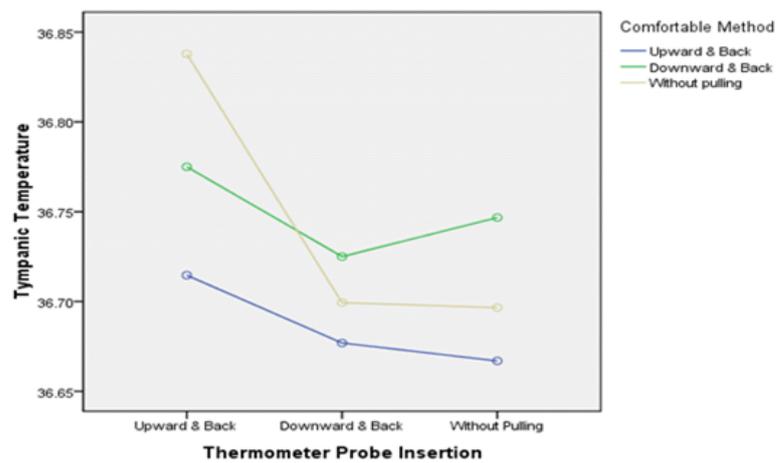


Fig. 2. Tympanic Temperature According to the Thermometer Probe Insertion & Comfortable Method

5 Conclusion

Three kinds of measurement methods were significantly different in their temperatures depending on gender or on participants' reaction to comfortableness. However, since the difference is within a small error range of 0.1°C or less, which is less than a margin of error that happens when measuring body temperature, it only has statistical difference and no clinical meaning. Therefore, although it is stated in

textbooks that when measuring the tympanic temperature of an adult, it is the most accurate to measure with the upward pulling of an ear, it seems like there will be no substantial difference if they measure in a way that participants feel the most comfortable.

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