

Determining the Ability to Accurately Assess Temperature Differences by Palpation: Investigation of Experienced Manual Therapists and Lay Individuals

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Palpation

- Skin temperature screening by palpation is component of patient examination by clinicians in multiple disciplines
 - Medicine
 - Podiatry
 - Chiropractic practice
 - Nursing
 - Physical Therapy
 - Occupational Therapy

Literature Review

- Common devices utilized in research studies to assess skin surface temperature: ¹⁴
 - Electrical thermistor
 - Contact thermography
 - Video thermography
 - Infrared beam thermography
- Substantial cost, time required

Literature Review

- Objective assessment and palpation have been used in research to detect temperature differences in conditions such as:
 - Reflex Sympathetic Dystrophy¹⁻³
 - Rheumatoid Arthritis^{13,14}
 - Osteoarthritis^{13,14}
 - Charcot Arthropathy¹⁶
 - Post-surgical inflammation¹²
 - Sciatica²³
 - Traumatic wounds⁶
 - Fever^{5-7,28}
 - Local infection⁶
 - Polyneuropathies^{4,15}
 - Vertebral Subluxation¹⁷

Literature Review

- Graneto and colleagues
 - Mothers' sensitivity/specificity
 - 84% Sensitive – correctly identifying febrile children
 - 76% Specificity – correctly identifying afebrile children
- Singhi and colleagues
 - Mothers' sensitivity/specificity :
 - 88.9% Sensitive
 - 88.6% Specific

Literature Review

- Nwanyanwu and colleagues
 - Fever assessment by nurse practitioners and mothers
 - Sensitivity
 - Clinicians 82.2%
 - Mothers 97.3%
 - Specificity
 - Clinicians 67.8%
 - Mothers 19.2%

Literature Review

- Singh et al
 - Three pediatricians palpated multiple anatomical locations on child to determine whether skin temperature was either above or below 36°C (96.8°F)
 - 100% sensitive and 90% specific in diagnosing temperature differences in skin of less than 36°C (96.8°F)

Literature Review

- Skin temperature varies throughout the body
- Anatomical temperature variation in healthy individuals:¹⁰⁻¹³
 - Middle finger: 31.25±0.93°C (88.25±1.67°F)
 - Knee: 29.5°C (85.1°F)
 - Forearm: 32.33°C (90.19°F)
 - Thigh: 31.95°C (89.51°F)

Literature Review

- Pathological temperature variation:
 - Extremity temperature decreases in patients with CRPS type I²⁶
 - 4.5±0.6°C max. average (8.1±1.08°F)
 - Knee temperature increases in patients with:^{13,14}
 - RA: 1.41°C-3.1°C (2.54°F-5.58°F)
 - OA: 0.5°C-4.6°C (0.9°F-8.28°F)

<i>Pathologic Condition</i>	<i>Mean Temperature of Unaffected Extremity</i>	<i>Mean Temperature of Affected Extremity</i>	<i>Mean Difference Affected vs Unaffected</i>
CHARCOT ARTHROPATHY ¹⁶	27.9°C (82.22°F) Overall mean	32.4°C (90.32°F) Overall mean	4.5°C (8.10°F) Overall mean
Tarsometatarsal Joint	28.0°C (82.4°F)	32.8°C (91.04°F)	4.8°C (8.64°F)
Transverse Tarsal Joint	27.5°C (81.5°F)	32.0°C (89.6°F)	4.5°C (8.10°F)
Ankle Joint	28.3°C (82.94°F)	32.3°C (90.14°F)	5.0°C (9.0°F)
NEUROPATHIC JOINT ¹⁶	28.7°C (83.66°F) Overall mean	31.8°C (89.24°F) Overall mean	3.1°C (5.58°F) Overall mean
Hallux	28.8°C (83.84°F)	30.6°C (87.08°F)	1.8°C (3.24°F)
1st Metatarsal	28.8°C (83.84°F)	31.8°C (89.24°F)	3.0°C (5.40°F)
2nd-4th Metatarsals	28.6°C (83.48°F)	32.5°C (90.5°F)	1.4°C (2.54°F)
5th Metatarsal	28.7°C (83.66°F)	32.3°C (90.14°F)	3.9°C (7.02°F)
POLYNEUROPATHY ¹⁵	33.1°C (91.58°F)	31.8°C (89.24°F)	1.3°C (2.34°F)

Purpose

- Assess the ability of experienced manual therapists and lay subjects to subjectively determine subtle temperature asymmetries by palpation.

Hypothesis

- Both clinicians and lay subjects will be able to accurately detect the warmer pad at temperature differences of 3°C→5°C (5.4°F→9.0°F).
- Clinicians will accurately detect the warmer pad at temperature differences of 1°C→2°C (1.8°F→3.6°F) and lay subjects collectively will not accurately detect the warmer pad at temperature differences of 1°C→2°C (1.8°F→3.6°F).

Methods: Subjects

- **Sample of convenience**
 - 10 healthy clinicians
 - 7 Females / 3 Males
 - Range of experience: 2 → 27 years
 - Mean experience: 10.7 years
 - 30 lay individuals
 - 22 Females / 12 Males
- UTC Students
- Siskin Physical Therapists

Inclusion Criteria

- **Inclusion Criteria**
 - **Clinicians**
 - Licensed PTs
 - Utilize a manual approach to physical therapy
 - >1 yr of experience
 - **Lay individuals**
 - No prior palpation experience
 - Ex. PT technician, PTA, Nurse, etc.

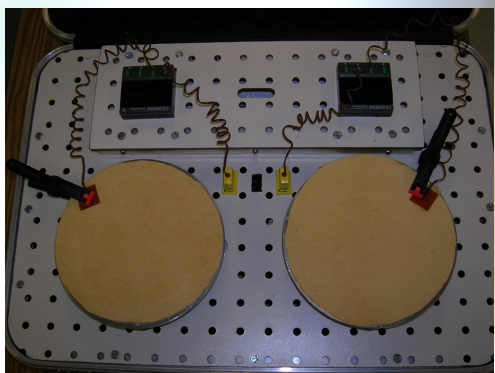
Exclusion Criteria

- **Exclusion Criteria:**
 - Minors
 - Individuals with a prior history of hand fracture/surgery
 - Individuals with a diagnosis of a skin hypersensitivity disorder
 - Sensory deficits
 - Neuropathies
 - Circulatory insufficiencies
 - DM
 - Clinicians from prior studies excluded

The Device

- **Designed by the UTC Engineering Dept**
- **Two metallic disks covered by chamois cloth which are heated to the desired temperature**
- **Calibration Accuracy: $\pm 0.3^{\circ}\text{C}$ (0.54°F)**

The Device



Experiment Adjustments

- **Both clinicians and lay palpation accuracy assessed**
- **Double-Blind Randomized protocol**

Randomized Protocol

Pad 1	Temperature Difference	Pad 2
30°C (86.0°F)	5°C (9.0°F)	35°C (95.0°F)
34°C (93.2°F)	3°C (5.4°F)	31°C (87.8°F)
31°C (87.8°F)	1°C (1.8°F)	32°C (89.6°F)
32°C (89.6°F)	2°C (3.6°F)	34°C (93.2°F)
33°C (91.4°F)	1°C (1.8°F)	32°C (89.6°F)
34°C (93.2°F)	4°C (7.2°F)	30°C (86.0°F)
31°C (87.8°F)	3°C (5.4°F)	34°C (93.2°F)
35°C (95.0°F)	5°C (9.0°F)	30°C (86.0°F)
34°C (93.2°F)	4°C (7.2°F)	30°C (86.0°F)
35°C (95.0°F)	2°C (3.6°F)	33°C (91.4°F)

Testing Procedure

- Palpate with the palmar surface of their dominant hand
- 10 seconds to palpate each pad per trial
- Indicate pad perceived to be warmer

Randomized Protocol

- 2 attempts at each of 5 temperature settings
- Total of 10 trials

Subject Preparation and Instruction

- Room temperature 21-24°C (69.8°F → 75.2°F)
- Subjects acclimated approximately 20 min prior to testing
- Subjects instructed not to hold hot or cold items in palpation hand
- Subjects not allowed to leave testing area during the period of acclimation

Procedure (cont.)

- Researcher controlling device blinded to subject response
- Researcher collecting data blinded to pad temperature
- Subjects blinded to temperature setting

Data Analysis

- Responses scored correct or incorrect
- Data analyzed using Chi-Square test
 - Data from clinicians and lay populations analyzed separately
- Statistical significance: $p \leq 0.05$

2006 Data – Lay Subjects

	Temperature Setting				
	1° Diff.	2° Diff.	3° Diff.	4° Diff.	5° Diff.
# Correct Responses	47 / 68 (69.1%)	49 / 68 (72.1%)	66 / 68 (97.1%)	61 / 68 (89.1%)	67 / 68 (98.5%)
Probability (p)	*0.002	*0.000	*0.000	*0.000	*0.000

•Results statistically significant for each of 5 temperature settings.

*Statistical Significance at $p \leq 0.05$ level

2006 Data - Clinician

	Temperature Setting				
	1° Diff.	2° Diff.	3° Diff.	4° Diff.	5° Diff.
# Correct Responses	12 / 20 (60%)	17 / 20 (85%)	20 / 20 (100%)	20 / 20 (100%)	19 / 20 (95%)
Probability (p)	0.371	*0.000	*0.000	*0.000	*0.000

•Results statistically significant for 2°C→5°C settings. Statistical significance not found with 1°C trials.

*Statistical Significance at $p \leq 0.05$ level

2006: Lay vs Clinician

	1° Diff.	2° Diff.	3° Diff.	4° Diff.	5° Diff.
# Correct Responses – Lay	47 / 68 *p=0.002	49 / 68 *p=0.000	66 / 68 *p=0.000	61 / 68 *p=0.000	67 / 68 *p=0.000
# Correct Responses – Clinician	12 / 20 p=0.371	17 / 20 *p=0.000	20 / 20 *p=0.000	20 / 20 *p=0.000	19 / 20 *p=0.000

•Results statistically significant for lay and clinicians at all temperature settings, with exception to 1°C for clinicians.

*Statistical Significance at $p \leq 0.05$ level

Discussion

- Hypothesis Confirmed
 - Both clinicians and lay able to accurately palpate temperature differences at 3°C→5°C (5.4°F→9.0°F) settings.
 - 3°C→5°C difference coincide with temperature variation of number of aforementioned pathological conditions.
- Hypothesis Disproved
 - Both clinicians and lay able to accurately palpate temperature difference at 2°C (3.6°F).
 - Clinicians within data collected in 2006 were not able to accurately detect 1°C (1.8°F) temperature differences whereas lay counterparts were able to palpate the differences at the 1°C (1.8°F) setting.

Conclusion

- Tentative Conclusion:
 - 2006 data suggests palpation experience does not affect ability to palpate temperature differences between surfaces with small temperature differences (1°C-2°C).
 - Palpation of temperature asymmetries reliable at large (3°C→5°C) temperature differences by both clinicians and lay subjects.
 - Guarded conclusions due to unequal number of participants in groups.

Discussion

- Variety of strategies observed subjectively by investigators
 - Palpation with palm vs. finger tips
 - Eyes closed vs Eyes open
 - Number of alternation between pad surfaces prior to giving response
 - Time required to give response at settings with small temperature differences (1°C→2°C settings)
- Did responses at smaller temperature differences coincide with first pad palpated?

Future Trials

- Standardization of palpation technique
 - Distal fingers vs palm
 - Standardize number of alternations between pads
 - Randomly assign starting pad
 - Require subjects to palpate for entire 10 second period before responding
- Equalize number of subjects in each group

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Palpation Quotes

“Three years of school...A lifetime of palpation!”

UTC DPT Class of 2008 Motto

“Palpation is very unreliable.”

Dr. Randy Walker

Questions

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Combined Results - Lay					
	1° Diff.	2° Diff.	3° Diff.	4° Diff.	5° Diff.
# Correct Responses	69/108	76/108	94/108	99/108	106/108
	63.9%	70.4%	87.0%	91.7%	98.1%
Probability (p)	*0.004	*0.000	*0.000	*0.000	*0.000

*Statistical Significance at p≤0.05 level

Combined Results - Clinicians					
	1° Diff.	2° Diff.	3° Diff.	4° Diff.	5° Diff.
# Correct Responses	44 / 60	42 / 60	59 / 60	60 / 60	58 / 60
	73.3%	70.0%	98.3%	100%	96.7%
Probability (p)	*0.000	*0.002	*0.000	*0.000	*0.000

*Statistical Significance at p≤0.05 level

Combined Results					
	1° Diff.	2° Diff.	3° Diff.	4° Diff.	5° Diff.
# Correct Responses - Lay	69 / 108 *p=0.004	76 / 108 *p=0.000	94 / 108 *p=0.000	99 / 108 *p=0.000	106/108 *p=0.000
# Correct Responses - Clinician	44 / 60 *p=0.000	42 / 60 *p=0.002	59 / 60 *p= 0.000	60 / 60 *p=0.000	58 / 60 *p=0.000

*Statistical Significance at p≤0.05 level