Tactile discrimination of surfaces: Role of physicochemical, mechanical and morphological human finger properties on the in vivo friction behavior

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Aim of this study

Development of tactile interfaces & stimulators

Friction forces modulation between the fingertip and an active counterpart

Problem: fingertip properties variability between individuals

- Fingertip roughness
- Skin mechanical properties
- Stratum Corneum chemistry

Friction behavior during touch

For 26 individuals (13 females and 13 males)

Surfaces scanned

Two sets of surfaces situated in the sticky / slippery psycho-perceptual dimension:

1. Real surfaces
2. Stimtac : Simulated surfaces

Sticky

Slippery

Varnished ABS (Ra = 1.6 µm)
PTFE (Ra = 0.7 µm)

Sticky Slippery

Varnished ABS
PTFE

Vibrating pad

Squeeze film effect

Friction measurements

Linear reciprocating tribometer

- Tangential motion direction of the right forefinger of individuals
- 1 pass: sticky & slippery surfaces
- Scanning speed = 4 mm/s
- Sliding distance = 40 mm
- Measurement of Fx and Fy
- Loading = 0.5 N (controlled by individuals)

Fricional Contrast

Frictional distinction of sticky/slippery surfaces

FC = 1 - \( \frac{\mu_{\text{slip}}}{\mu_{\text{stick}}} \)

\( \mu_{\text{stick}} = \frac{\mu_{\text{stick}}^1 + \mu_{\text{stick}}^2}{2} \)

\( \mu_{\text{slip}} = \frac{\mu_{\text{slip}}^1 + \mu_{\text{slip}}^2}{2} \)

Results

Validation of Stimtac as a good tactile friction forces modifier for sticky/slippery surfaces simulation

Gender influence on \( \mu_{\text{stick}}, \mu_{\text{slip}} \) & FC

Bad correlation of \( R_t, S_p \) or \( E^* \) with both Frictional Contrast & COFs (\( \mu_{\text{stick}} \) or \( \mu_{\text{slip}} \))... But...

Hydrolipidic film composition is highly responsible of Frictional Contrast values for sticky/slippery flat surfaces