MECHANORECEPTOR ACTIVATION FROM TOPICAL TREATMENTS MODULATES THE SENSORIAL PERCEPTION OF OUR SKIN

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1 INTRODUCTION

Perception of sensorial experiences arises from the mechanical stimulation of mechanoreceptors located below the skin surface and activation of afferent neurons which carry signals to the central nervous system. The objective of this study was to develop an *in vitro/in vivo/in silico* framework to understand factors that contribute to the perception of skin tightness. We then use this knowledge to develop an optimized moisturizing formula capable of minimizing skin discomfort while still providing typical skin care benefits of a moisturizer.

2 MATERIALS & METHODS

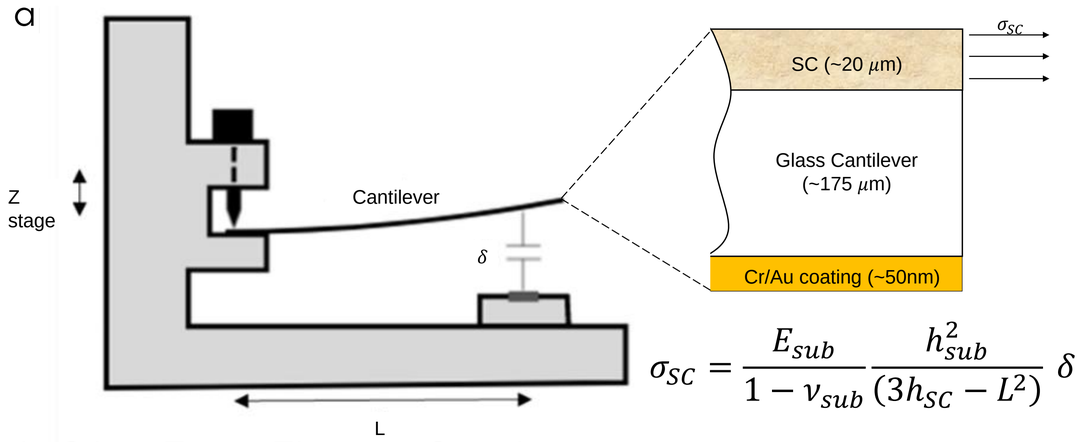
A three-pronged approach was used, consisting of *in vivo*, *in vitro*, and *in silico* methods.

In Vivo Clinical Study

Clinical assessments were performed on two groups of women suffering (n=30) or not (n=30) from tightness. Skin tightness felt on the cheek and forehead were assessed on a 4-point scale (0-3) following application of either a cleanser by itself or cleanser with Osmoskin® moisturizer. Skin hydration, transepidermal water loss, oiliness, and mechanical properties were concurrently measured.

In Vitro Mechanical Stress Measurements

Human female abdomen stratum corneum (SC) was adhered to a glass cantilever. Mechanical stresses develop in the SC as it dries, bending the pinned cantilever [1]. Deflection of the cantilever was used to calculate SC film stresses before and after formulation a

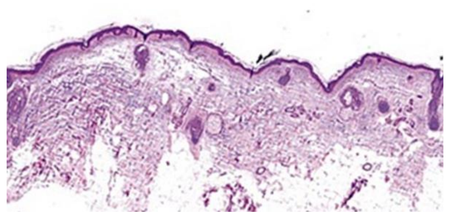


$$\sigma_{SC} = \frac{E_{sub}}{1-\nu_{sub}} \frac{h_{sub}^2}{(3h_{SC} - L^2)} \delta$$

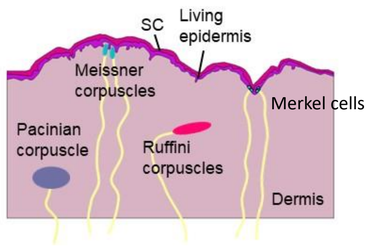
In Silico Finite Element Simulations

Histological sections [2] of human cheek and forehead were translated into a 2D multi-layered finite element (FE) model. Stresses measured in the lab were inputed into the model to obtain deformation fields at mechanoreceptor locations.

Cheek Histological Section

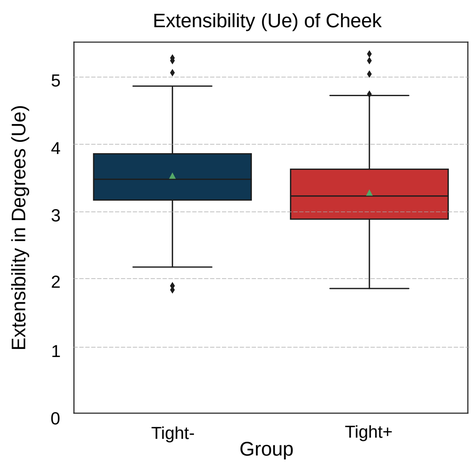


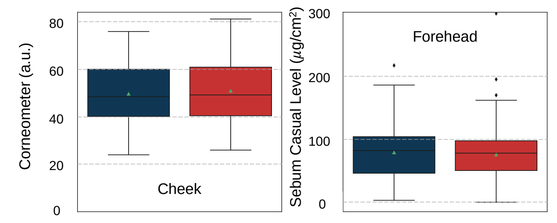
Finite Element Model

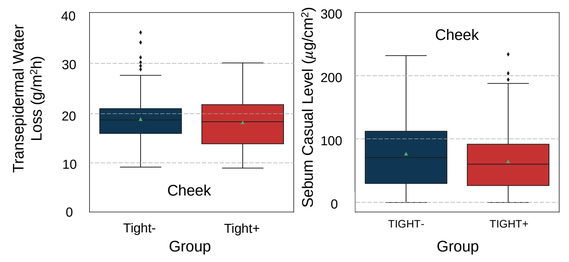


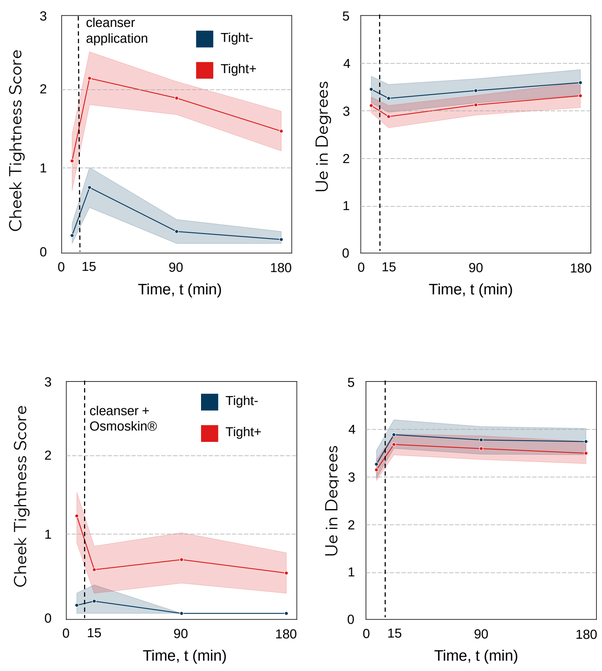
3 RESULTS & DISCUSSION

Women prone to tightness (Tight+) have a more rigid SC than their counterparts (Tight-), but no other correlation was found between tightness perception and other measurements (except tendency of sebum level on cheek).

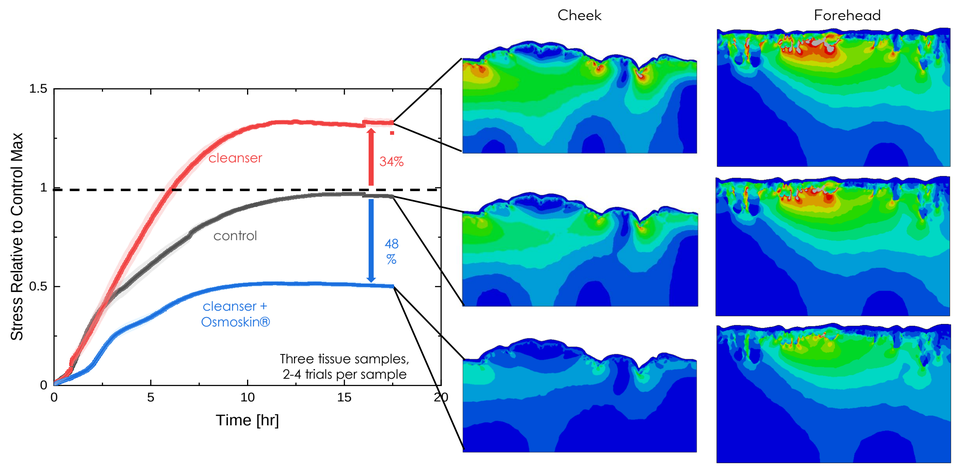








Tightness scores increase sharply following application of a cleanser in both groups; this is coincident with an increase in SC rigidity. *In vitro/in silico* results show the corresponding increase in stress and activation of cutaneous mechanoreceptors. In contrast, application of a cleanser with Osmoskin® results in a decrease or elimination of skin tightness. This coincides with reduced stresses and less deformation.



4 CONCLUSIONS

A novel framework for understanding how skin tightness sensations form and propagate through the integration of *in vivo*, *in vitro*, and *in silico* approaches was created. *In vivo* clinical trials were used to investigate the reasons behind the tightness perception dichotomy of consumers with a high (Tight+) or low (Tight–) sensitivity for tightness; *in vitro* experiments were used to measure the mechanical stresses induced in the SC after cleanser and moisturizer application; and *in silico* simulations were used to illustrate how measured mechanical stresses in the SC result in the development of strains at the depth of cutaneous mechanoreceptors, triggering tightness perceptual responses. An optimized moisturizer, Osmoskin®, was developed and tested to alleviate these perceptions.

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