A Flexible Wearable Interface for the Mechanical Characterisation of Soft Tissue Changes During Disease Progression

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What is the Problem?

- Currently, the NHS spends over £5 billion annually to treat skin conditions such as wounds, burns, and dermatitis [1]
- Key diagnostic methods for such conditions rely on the visual and tactile assessment of skin to appraise pathological health [2]
- This subjectivity fails to account for the disparities in disease presentation due to variations in age, sex and skin colour [3]
- Overall, this has led to a 23% error rate in diagnosis, putting strain on healthcare systems and decreasing a patient’s quality of life [4]

How Do We Do This?

- Using millimetre scale vibrational sensors, we send sound waves through the skin.
- Small receivers are used to “listen” to these waves as they travel.
- The variation in wave speed is then used to characterise the tissue
- Mechanical properties are monitored over time to assess tissue health
- For example, in eczema, the tissue becomes dry and thick so our sensing mechanism would detect an increase in mechanical stiffness

What is our Approach?

- The progression of skin diseases causes local tissue changes such as inflammation, fluid retention and skin thickening
- These changes can be linked to the mechanical properties (elasticity and viscosity) of the diseased site
- We are using this to enable the creation of low-cost, wearable mechanical assessment devices that can monitor disease over extended time periods

What Did We Find?

- The full sensor assembly is created using very simple manufacturing methods and low cost materials
- Clinician discussions occurred throughout this process, ensuring physician usability and patient safety
- Tissue-sensor adhesion lasts for up to 7 days, allowing for continuous monitoring both in clinics and at home
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Monitor

- Initial human testing has shown our sensors can detect tissue damage in wounds. We observed a reduction in stiffness to the top skin layer (epidermis) from a burn, with little damage seen in deeper layers.

Conclusion

- We have developed a wearable mechanical sensor to monitor skin disease over extended time periods using a non-invasive, low-cost approach
- The sensor is able to obtain mechanical information from each tissue layer, with human tests demonstrating our ability to detect damaged and undamaged layers
- Our solution offers an alternative to current diagnostic methods. Our device has the potential to be used within NHS facilities or at home, greatly reducing the cost and strain currently seen by our healthcare service

References