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In Vivo Biomechanical Measurements of Benign and Cancerous Skin Lesions Using Vibrational Oct

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Abstract: Previous literature reports suggest that tissue stiffness is a predictor of cancer and metastatic behavior of lesions. We have used optical coherence tomography and vibrational analysis (VOCT) to characterize normal skin, scar, a verrucous carcinoma (a squamous cell carcinoma subtype), a basal cell carcinoma and benign skin lesions non-invasively and non-destructively. The results suggest that epidermal thickening and increased keratin and basal cell production occur in malignant lesions and lead to increases in surface hills and valleys as well as subsequent increases in epidermal stiffness values. Increased stiffness of the epidermis is a result of increased keratin and basal cell production while the stiffness of the dermis remains similar to that of normal skin, suggesting that dermal changes are not observed in these lesions.

Measurement of the resonant frequency of the epidermal and collagen peaks of both benign and malignant skin lesions suggest that the width and location of the peaks is altered in malignant lesions. In normal skin, the epidermis is too thin to measure the resonant frequency while in benign and malignant lesions the epidermis is increased in thickness and the cellular resonant frequency can now be measured. However, the resonant frequency of the epidermis in benign lesions is 40 Hz while that of malignant lesions increases to about 50 to 60 Hz and the peak width increases. In normal skin the collagen peak is 90 to 100 Hz while in both benign and malignant lesions the collagen peak increases to 160 to 180 Hz. The location in Hz of the epidermal and the collagen peaks along with the peak heights and widths can be used to differentiate benign and malignant skin lesions.

It is concluded that VOCT may be a useful adjunct to dermoscopy and other clinical tools to identify and characterize lesions as small as 0.2 mm. It is hypothesized that the slow growth potential of basal and squamous cell carcinomas may be related to the lack of dermal involvement and that other more invasive skin lesions may be characterized by both epidermal and dermal involvement that would lead to changes in both epidermal and dermal stiffness.

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