

IN-VIVO BILAYER MATERIAL YOUNG MODULI IDENTIFICATION USING SUCTION ONLY

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An original *in vivo* suction system is proposed to estimate soft tissue stiffness, based on volume measurements [1], which enables extreme customisation of the suction aperture shape and diameter. Cyclic (repeatability, no leakage testing) partial vacuum tests are applied under small tissue strains using six suction cups of aperture diameters ranging from 6 to 20 mm. Each test extracts mechanical behaviour information integrated over about one-diameter depth inside the tissue [2].

Experiments are then all compared to their simulated Finite Element (FE) counterparts (bilayer structure, two Neo-Hookean layers) using a single least-squares cost function. An FE database was used to enable real-time identification of three mechanical parameters (the upper-layer thickness and the two materials' Young's moduli). This evaluation also provides patient-specific parameters' indifference regions [3].

The system was evaluated on bilayer-controlled silicone phantoms (3 mm upper-layer), with Young's moduli identified by suction and uniaxial tension presenting a relative difference of less than 10%. Preliminary tests on *in vivo* abdominal tissue provided the skin and underlying adipose tissue Young's moduli at 54 ± 1 kPa and 4.8 ± 0.1 kPa respectively. The skin upper-layer thickness was measured at 2.21 ± 0.033 mm using B-mode ultrasound and was identified at 2.15 ± 0.05 mm using suction data only.

References

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3. Connesson N *et al.*, Experimental Mechanics, 2023, 63:715–742