Macro-mechanobiology of Scarring: *In vivo* human study of scar stiffness using shear-wave elastography

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BACKGROUND: Mechanobiology research using *in vitro* and animal models have demonstrated that increased matrix stiffness and/or increased tissue strain promotes excessive scar formation [1]. In addition to scarring, a burn injury increases the risk of developing chronic musculoskeletal disorders [2]. This research is investigating the hypothesis that a bi-directional mechanical continuum exists between the dermal and subcutaneous connective tissues influencing scar formation and functional recovery following a burn. Shear-wave elastography is being used as a novel method to quantify *in vivo* stiffness of both injured dermis and the surrounding non-injured subcutaneous tissues.

METHODS: A prospective, cross-sectional study of adult patients with partial thickness (dermal only) burns, recruited from the Fiona Stanley Hospital burn injury unit, is currently underway. Up to three scar sites and three matched, contralateral non-injured skin sites are being evaluated with a Siemens ACUSON S3000, using a 9L4 transducer, to image the stiffness of the skin through to muscle. Both qualitative analysis of elastograms and quantitative measurement of shear-wave velocity (m/s) are being evaluated.

RESULTS: Preliminary results (n=35 scars) demonstrate an association between pathological dermal scars and increased stiffness of underlying non-injured subcutaneous adipose tissues, and in some cases, increased stiffness of the perimuscular fascia. In addition, maximal isometric muscle contraction and passive stretch can influence the stiffness within the dermis.

CONCLUSION: Preliminary evidence from this research suggests that pathological scarring of the skin is associated with altered mechanical properties of subcutaneous tissues. Contraction of underlying muscles can alter the skin/scar stiffness, suggesting that muscle contraction can influence strain within the skin. Identifying a bidirectional mechanical continuum between the skin and underlying adipose and/or myofascia may elucidate macro-mechanical factors influencing scar formation and the development of musculoskeletal disorders following a partial thickness burn. This information will assist the optimisation of treatment delivery including the use of compression, manual and movement therapies, and assist the development of new treatments.