Mechanical properties of the porcine oesophagus assessed using biaxial testing

Nick Newton[1], Benyamin Rahmani[2], Gaetano Burriesci[2], Gavin Jell[1]

[1]Division of Surgery and Interventional Science, [2]Department of Mechanical Engineering, University College, London

INTRODUCTION: The use of interventional endoscopic procedures has increased the interest in tissue regeneration in the oesophagus to develop techniques to mitigate the effect of post-operative leaks and perforations[1, 2]. This project characterizes the material properties of the oesophagus to allow the development of materials that better match the properties of the native tissue for use in regenerative applications. Biaxial mechanical testing was performed to assess the mechanical behaviour of porcine oesophagus.

METHODS: The oesophagus was retrieved from recently terminated porcine specimens and tested within four hours. Six 16 mm × 16 mm samples 3 mm in thickness were analysed using a biaxial testing system in a 37 ^{o}C water bath (Cellscale Biotester) (figure 1). Preconditioning, to ensure alignment of fibres, consisted of 5 repetitions of 10% load and equi-biaxial testing consisted of a single 40% load in the longitudinal and circumferential axes.

RESULTS: The results demonstrate minor anisotropy of the oesophageal tissue with stress of 4 MPa at 40% strain in the circumferential axis and 3 MPa at 40% strain in the longitudinal axis. The elastic modulus was 1.3 kPa and 1.6 kPa in the longitudinal and circumferential axes respectively at 40% strain.

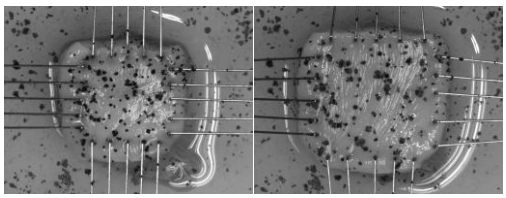

Fig. 1:Images of oesophageal sample loaded on CellScale biaxial testing system at 0% strain (Left) and maximum strain (Right).

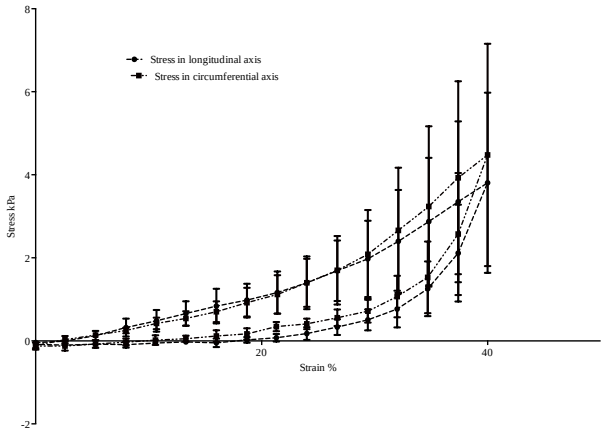

Fig 2:Stress-Strain graph for oesophageal specimens showing mean (kPa) and standard deviation

DISCUSSION: The oesophagus is a target for tissue regeneration following therapeutic endoscopic procedures, post-operative anastomotic leaks and iatrogenic injuries[3]. Self-expanding stents are the current mainstay of treatment, however these disrupt the normal anatomy and function of the oesophagus[4]. Understanding the biomechanical properties is vital for the development of improved materials that match the properties of the oesophagus and can allow the development of better stents or other novel devices including materials applied to the lining of the oesophagus to promote in situ tissue regeneration.

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