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Mechanisms of Human Gallbladder Pain

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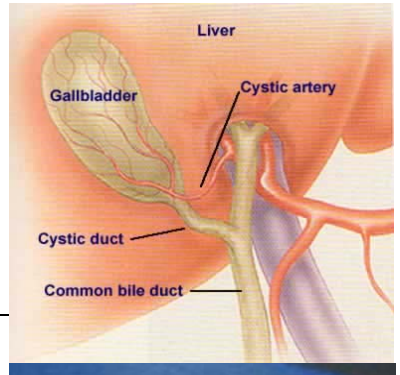
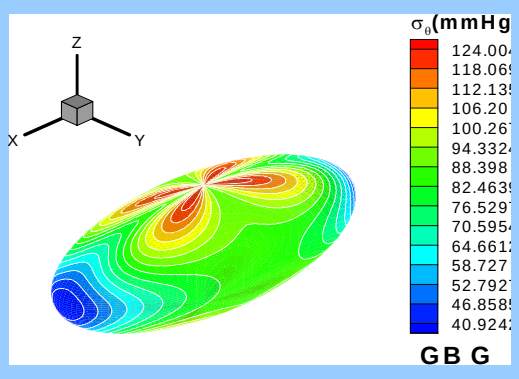


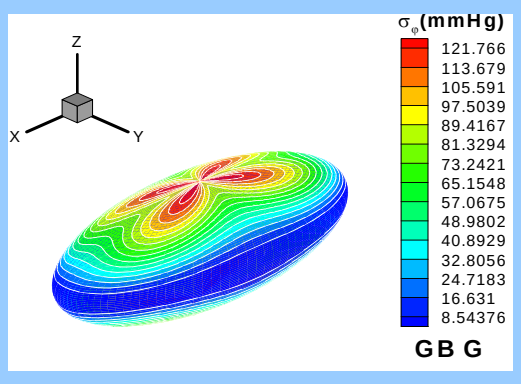
Gallstones found in vivo.

Project Outline

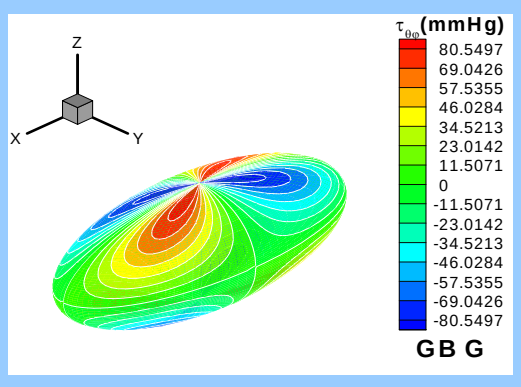
Gallstone and other diseases of the biliary tract affect more than 10% of the adult population of the UK. Up to 60,000 operations to remove the gallbladder are being performed in the UK each year, at a cost of approximately £40 million to the NHS. The mechanism of the pathogenesis of gallstones and pain production are poorly understood, and the complications of gallstones, i.e. acute pancreatitis and obstructive jaundice, can be lethal. The aim of the research is to establish a new concept by carrying out a 3D non-linear stress analysis of the gallbladder including both the passive and the active stresses. The model is tested against controlled clinical experiments for various subjects.



Principle meridian stress



Principle latitude stress



In-plane shear stress

Initially, a gallbladder is assumed to be a simple ellipsoid with a uniform thickness and mechanical properties. The total stress can thus obtained analytically. A typical distribution of normal stresses and shear stress is shown above. The model shows that the location and value of the maximum stresses will change depending on the ratios of the three axes, as well as the pressure and (implicitly) the volume change. It is found that the peak normal stress may be used as an effective pain indicator for gallbladder pain. When this model is applied to clinical data of volume changes due to CCK stimulation of 37 patients, it shows a promising success rate of 88.2% in positive pain prediction. More work on smooth muscle contraction as well as wider range of clinical sampling will be carried out .

References (downloadable from http://www.maths.gla.ac.uk/~xl):

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Acknowledgement

This project has been founded by EPSRC (Grant No. EP/G015651).