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DEVELOPMENT OF ATRAUMATIC, NON-SLIP, FORCE-CONSTRAINED LAPAROSCOPIC FORCEPS.

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Introduction

Surgical manipulation leads to an intestinal inflammatory response that contributes to post-operative ileus, increases the risk of complications and delays discharge. There is an immediate need for totally atraumatic instruments.

Study design

We have manufactured polymer micropillar arrays with custom geometry and hydrophilicity. We applied this novel adhesive surface to the jaws of standard laparoscopic forceps and integrated force and displacement sensors into the handles to enable calculation of the force applied to tissue.

Parametric studies will investigate the influence of key factors (geometry, hydrophilicity, retraction force, grasping force) on the grip and retraction performance of the modified forceps. Ex-vivo porcine tissue will be used. After mechanical testing, tissue damage will be assessed histologically to define 'safe' limits.

Pilot data

An adhesive force of 70mNcm-2 was achieved with micropillars applied to peritoneum. The surface provided resistance to lateral traction with a high friction co-efficient of 1.5. A capillary mechanism is proposed, as hydrophobic surfaces were not adhesive.

Recorded data from the instrumented forceps demonstrate accurate measurement of the tissue-jaw interaction forces and display the visco-elastic properties of tissue. A pronounced relaxation phase seen during extended holds may be correlated with tissue trauma.

Forward plan

In-vivo animal studies will allow tissue stress to be quantitatively correlated with histochemical changes, defining the inflammatory response associated with surgical manipulation. This data will inform the force constraints of a working prototype. Limiting tissue stress in this way can potentially eliminate the intestinal inflammatory response and further enhance the benefits of laparoscopic surgery.