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DRAGONFLEX
SMART AND SIMPLE STEERABLE LAPAROSCOPIC INSTRUMENT

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Background – Despite its success, e.g. in prostatectomy, da Vinci's steerable grasper EndoWrist from Intuitive Surgical has a complex design prone to steel cable fatigue, potential sterilisation issues and associated high costs, all of which insinuate a need for an alternative.

Aim – Design a structurally simple handheld disposable steerable laparoscopic grasping forceps free from cable fatigue, while attaining sufficient bending stiffness for surgery and improving on EndoWrist's manoeuvrability and dimensions.

Description – Having equal functionality to EndoWrist, DragonFlex's instrument tip contains only four parts, driven and bound by two steel cables mechanically fixed in the handle. Two orthogonal planar joints feature an innovative rolling link mechanism allowing the cables to follow circular arc profiles of a diameter 1.5 times larger than the width of the instrument shaft. Besides maximising the cable lifespan, the rolling link was designed to equalise the force requirements on both cables throughout joint rotation, making the handling fluid and effortless. The smart joint design and stacked instrument construction enable control of 7 degrees of freedom by only 7 structural instrument components.

Results – Two DragonFlex prototypes were developed by means of rapid prototyping technology, allowing grasping and omnidirectional steering over +/-90°, exhibiting promisingly high bending stiffness and featuring extreme simplicity at 5 mm dimensions. The DragonFlex concept sheds new light on the possibilities of rapid prototyping manufacture of surgical instruments, allowing for a feature-packed design, simple assembly and suitability for disposable use.

Acknowledgements – This research was supported by the Center for Translational Molecular Medicine (project MUSIS).