

Development and Design of a Multi-Functional Laparoscopic Instrument



Figure 1: Laparoscopic equipment in the OR (Photo source: <https://byrlmed.com/product/byrl-laparoscopic-dissecting-grasping-forceps/>, accessed 7 February 2021).

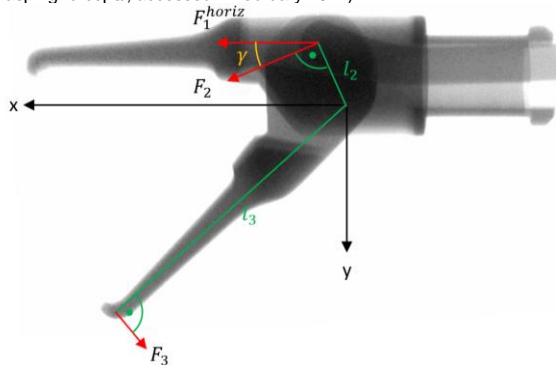


Figure 2: CT scan of a laparoscopic tool to analyze the kinematic relations of the gripper (Picture: L. Eggenberger).

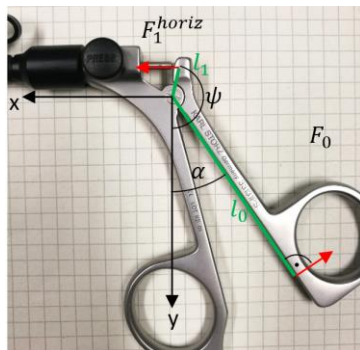


Figure 3: Kinematic analysis of a photo of the hand grip of a laparoscopic tool (Picture: L. Eggenberger).

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The medical engineering market is one of the most innovative parts of the international economy. In this interesting field, big players work alongside small business to design top-notch medical devices to improve and save the life of thousands of patients [1, 2, 3].

This project resulted from first hand experiences of surgeons during their work with laparoscopic devices in the OR. While using the existing laparoscopic tools, we have discovered so far untouched improvements to the existing functional principles. Most of the currently existing tools have exactly one function and are single use devices. Therefore, we conceptualized a multifunctional, multiuse laparoscopic device.

This thesis aims at developing basic technical functionalities for a new multifunctional laparoscopic instrument. It will allow the surgeon to perform one-handed tool-tip changes without extracting and reinserting the laparoscopic instrument. Thereby, the surgeon creates less risk for infections through repeated device insertion and extraction, the surgeon can keep the focus on the surgical site and saves overall time. For the patient, shorter intervention times (5-15 minutes) lead to less application of anesthesia and therefore, a faster recovery.

As a first step towards developing device functions for the multifunctional laparoscopic instrument, the requirements for different functionalities of the tool were derived. In particular for the tool-tip extraction and reinsertion, the requirement list was found to be challenging to fulfil: a lightweight mechanism that allows robust, one-handed tool-tip exchange by pressing one button, while the haptic connection between hand grip and tool-tip should remain.

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