

## **Design of an electro-mechanical surgical retractor for anterior abdominal wall retraction**

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**Introduction** - Open abdominal surgeries commonly rely on surgical retractors to maintain exposure to the surgical site. Hand-held retractors are one of the commonly used retractor types in open abdominal surgery in Sri Lanka. While they facilitate maintaining exposure to the surgical site, these devices often contribute to operator fatigue and tissue trauma due to prolonged and inconsistent retraction. The project aimed to design an electro-mechanical surgical retractor that minimizes user fatigue and reduces tissue damage.

**Methods** - Through a structured design process, the team identified the key functional and ergonomic requirements of such a system. Initial research included a detailed literature review and stakeholder interviews at Teaching Hospital Kalutara with surgeons and surgical assistants.

The team followed a systematic design approach involving functional analysis, morphological chart development, and evaluation of multiple design concepts. The Pugh decision matrix was used to select the most promising solution, and a final 3D design was created using SolidWorks software.

**Results** - The interviews revealed that manual retractors are widely used in Sri Lanka due to easy accessibility and cost effectiveness, but they result in common challenges such as hand fatigue, unstable positioning, and frequent manual adjustments. These factors contribute to surgical distractions and potential tissue trauma during prolonged procedures. Insights also highlighted the need for retraction systems with hands-free control, adjustable force, and enhanced safety.

**Discussion** - The final 3D design integrates motorized symmetrical linear motion, foot pedal control, inflatable air bladders to minimize pressure damage, LED lighting for improved visibility, and real-time pressure sensors that provide audio alerts to avoid excessive force application. A mechanical override mechanism ensures safety in case of power or motor failure.

Overall, the work completed has resulted in a well-defined, user-informed, and safety-focused retractor design, laying the foundation for the development of a functional prototype, usability testing, and clinical validation in future stages.

**Keywords** - Abdominal surgery, Electro-mechanical surgical retractor, medical device, Pressure sensing