



1ST INTERNATIONAL CONGRESS
ON
ADDITIVE MANUFACTURING
BOOK OF ABSTRACTS

IWAM 22



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WELCOME

Additive manufacturing technologies are playing a decisive role in the laboratory environment, making a significant difference in STEAM education. Students use additive manufacturing to create physical models, topographic maps, biology artifacts, artwork, all types of engineering prototypes and solving mathematics challenges. By bringing additive manufacturing capabilities to the classroom, educators can raise interest in STEAM, introduce new concepts and capabilities, and help set the future for more skilled STEAM professionals.

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Manufacture and development of a 3D printing handle for laparoscopic application

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ABSTRACT

Laparoscopy is a minimally invasive surgery (MIS) technique that began to be developed approximately a century ago and due to its advantages, such as the rapid recovery of patients, it has become the focus of several studies for the improvement of the equipment and the technique. However, the equipment has a serious ergonomic problem in its configuration, which causes several musculoskeletal problems for surgeons causing, for example, muscle pain, temporary paresthesia, and fatigue, among other long-term pathologies. The study and development of new handle models and the reduction of the forces required for their manipulation are of fundamental importance in the field of laparoscopy. In this sense, this work presents the integration of the product development method of Pahl and Beitz (2007) and the DSR (Design Science Research) method for the development of a laparoscopic instrument, to be applied in tweezers and scissors, that meets the ergonomic requirements presented in the literature.

INTRODUCTION

The history of surgery was marked by several events that allowed us to evolve into the complex practices we know today. The need to inspect the body cavity to obtain more accurate diagnoses motivated the development of equipment that made it possible to perform these procedures without causing much harm to the patient. Initially used as a technique to obtain a diagnosis, laparoscopy has evolved into a minimally invasive surgical technique. This technique facilitated the patient's recovery, as it did not require the abdominal cavity to be fully opened to perform a particular surgical procedure (Amato 2016)(Almeida 2002).

All technological advances in this field have focused on the patient's well-being and recovery; however, it has only been in recent years that attention has been paid to the health problems that physicians may develop as a result of the continuous use of these devices. The most serious issues are concentrated in the field of ergonomics, because the surgeries are lengthy and necessitate specialized permanence for an extended period of time (Berguer et al., 1999).. The goal of this work is to design an ergonomic pistol-type instrument that can be applied to laparoscopic instruments used in minimally invasive surgeries to reduce the efforts applied by the surgeons' fingers and improve their positioning during surgery.

RESULTS

The pistol model was chosen because, according to the literature, it has a more comfortable format than traditional handles, as shown in Figure 1. Figure 2 highlights some details of the prototype, demonstrating how it meets the requirements of the literature. Figure 2 (A) shows the 135° angle between the axis and the handle, which

keeps the hands in a neutral position (Gonzalez, Salgado, and Moruno 2015; Van Veelen et al. 2003). The location of one of the control mechanisms is highlighted in Figure 2 (B).

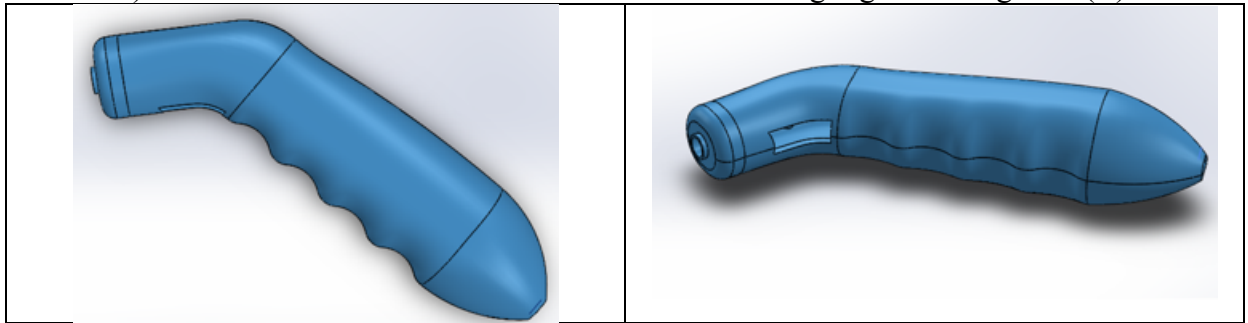


Figure 1 - Handle prototype versions.

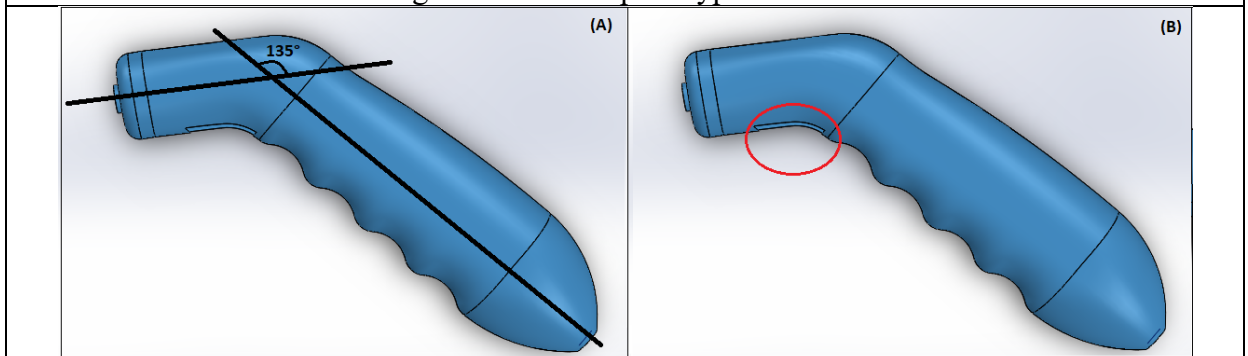


Figure 2 - Ergonomic features of the prototype.

The handle is ergonomically designed for the fingers and adheres to the requirement that the grip be done with the palms of the hands for a larger contact area. The cylindrical cross section was chosen because it is more comfortable, and the diameter adheres to the recommended range of 30 to 50 mm in the literature. Other details worth mentioning are all edges are rounded, the design is symmetrical, and the cable length is approximately 125 mm, which is considered more comfortable.

CONCLUSIONS

In this work, a model of an ergonomic laparoscopic instrument was developed, for application in tweezers and scissors for minimally invasive surgeries. After an extensive review of the literature, the need for new models of laparoscopic instruments that meet ergonomic requirements to avoid musculoskeletal injury to their users was proven.

During the development of the present study, it is believed that one of the most important points found was the proof that the pistol grip model is more comfortable for the user. This fact directed the entire project toward the final model presented.

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