

Design and calculation of a New Mechanism in an Endoscopic Surgical Instrument

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1- ABSTRACT

The purpose of this paper is how engineer can design a good system to help the doctor in the hospital for any surgery by using mechanism in Endoscopic instrument. So, in this paper used some medical requirements to help us in this design and did the best idea for design a new endoscopic devise. Actually, the important part in this article is calculations for design driving mechanism in Endoscopic instrument for surgical application because the new mechanism design of the surgical instrument aids in better ergonomic design, reliable functionality, and continuous cost reduction in product manufacturing. CAD program, functionality analysis, and computer aided solution have been applied to the instrument design, development and future improvement to meet the specific requirements of minimally invasive surgery procedure For example, how to recognize the inflicted force around this device and knowledge the measuring of angles and lengths appropriate so we can know

reflexes for this system. In this study that showed concentrate in these calculations of paper to get that; the loading of the force should be 4 pounds or less than 4 pounds to move the force through the mechanism to have pushing force is 20 pounds. Therefore, the doctor can close the clips excellently. The prototypes of this new design are analyzed through computer aided modeling and calculation, in order to prove its feasible functionality, reliable performance, and mechanical advantage. All these improved features have also been tested and verified through the prototypes.

Keywords: Design; new endoscopic devise; Calculation; CAD program; mechanical advantage

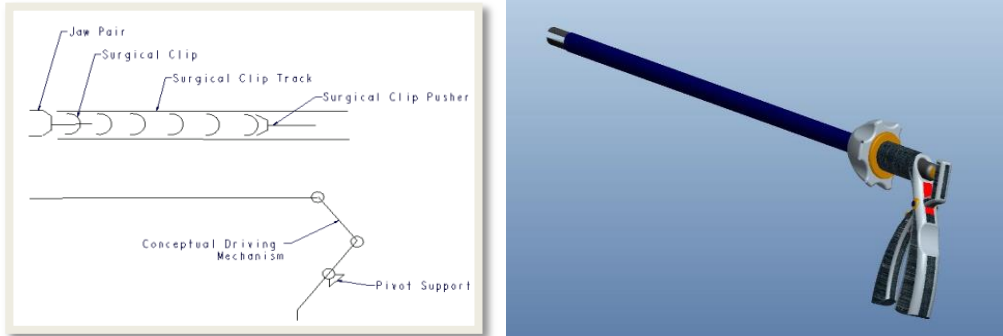
2- INTRODUCTION

Biomedical engineering is the most important part in the development of medical endoscope devise [1].The positive and possible changes in surgical instruments get led to the new development of surgical instruments techniques[2].The surgery by the endoscope was not guaranteed but Biomedical Engineering has developed these devices in hospitals [3].The surgical instrument trade is so competitive, price sensitive and pictorial by using advanced technologies [4] and [5]. The technology of biomedical and surgical instrument is concentrates about product and normally advanced techniques are especially required to improve special technology to challenge the products

in today's competing market [6] and [7]. The endoscopic surgical instrument has been used to stop next to polypectomy bleeding, posting of entreat feeding tubes[8] and [9]. The recent studies show the versatility of endoscopic surgical clips in therapeutic and endoscopic applications. The new technology that opens and aligns the jaws in the same time the jaws has been implemented, allowing well controlled surgical clip feeding and closure. This new surgical instrument design can improve more consistent and reliable mechanism to protect the clip from external and unanticipated disturbance while the surgical clip sits in the jaw track. Surgical instrument was used endoscopic on a large scale for homeostasis during endoscopic upper and lower gastrointestinal bleeding lesions, which can be done successfully lead. There are many studies compare between endoscopic surgical clips and thermal treatment, these studies verify that the footage endoscopic surgical reason less trauma to the mucosa around the ulcer of ironing electric.

3- ANALYSIS OF INSTRUMENT

Figure(1.A) shows the important parts for a new device of the surgical instrument. Also, figure (1.B) shows new design of



surgical instrument to get

perfect design and good system to help doctors how they can use this new device.

Figure 1.A Important parts of device Figure 1.B New design of surgical instrument

Actually, the figure (2) shows indicates the cross-section of new surgical instrument by using these steps:-

1- **The expected force in the mechanism of this device system for closing the clip.**

Engineer should do good and accurate accounts about this device, to get the correct results in a good time. Also, this work should be good for doctor to get medical successful outcomes. The other important thing is the force which is force between

the jaw pair to move the clip and close it. This force is 4 pounds or less, and repeating this step 25 times or more.

2- Pushing the clips should be continuously.

In this step, should continue to press the trigger in order to ensure the continued success of this step nonstop. Also, the clip has geometry is very important to keep the device works without feeding. As a result, pair jaws can reach with together without space between clips.

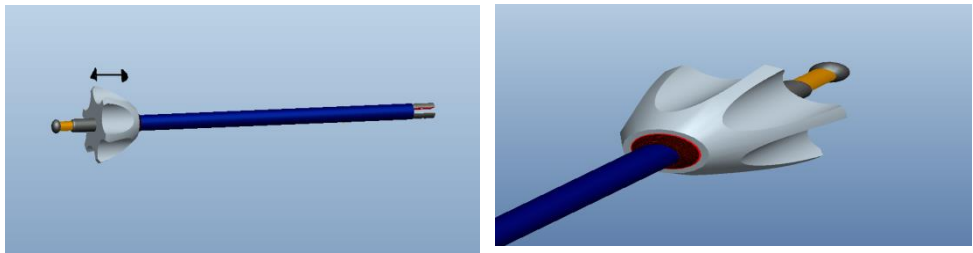
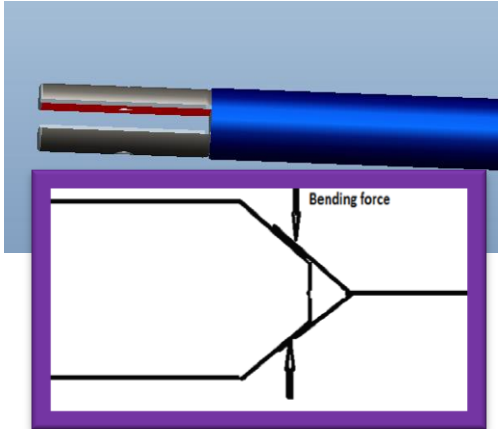


Figure 2. Indicates the cross-section of new surgical instrument

4- THE JAW PAIR

Concentrating about this part in this paper is very necessary because it is one of important parts in a new design for endoscopic instrument. For instance, the force of this device should be equal on the two pairs and dimensions should be accurate to get perfect lengths by using deferent equations. Also, the jaw should be made of elastic material because this kind of material is very good for open and close the jaw pair, and the doctor can control himself when he or she uses this device do you know why? Since this material is soft, and it is suitable for

the performance of surgical procedures. As a result, the jaw pair is the important part in my project because the most of this system or design based on this part to getting correct equations.



The figure (3) shows a new surgical instrument of the jaw pair mechanism.

Figure 3. New surgical instrument the jaw pair mechanism.

5- COMPUTATIONAL MODELING.

(MECHANISM CALCULATION).

The figure (4) is showing the AB represents the trigger handle; BD is the linkage arm that has a pivot support in the middle at the point C. Also, the bar EG is the pusher and the track where the clips move forward. This section will illustrate how to calculate the lengths and the angles that the instrument has, and do some moment, force balance.

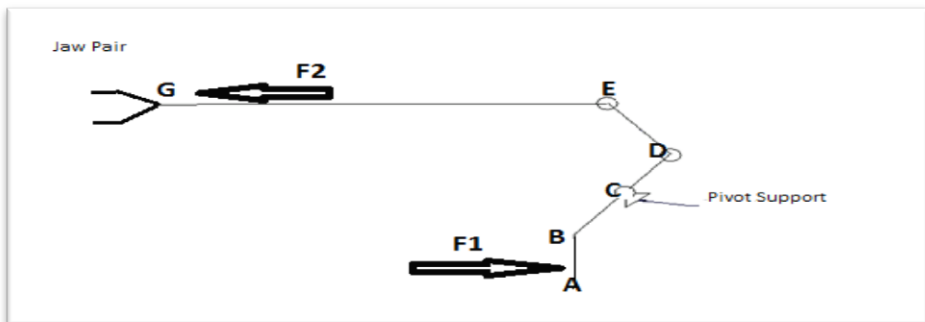


Figure 4. Mechanism Calculations

Where F_1 is Surgeon's finger applied force, F_2 is the force to close the jaw B_1 is the angle between CD and DE, B_2 is the angle between CD and EG. Assuming that the hand of the surgeon will apply the force F_1 by squeezing the trigger on the point of 0.8 of the length of AB.

First:

Taking the moment at the middle of BD at pivot point.

$$F_1 [0.8 AB + BC \sin(B_1)] = F_2 [(ED \sin(180 - B_2)) + (BC \sin(B_1))]$$

$$F_2 = \frac{F_1 [0.8 AB + BC \sin(B_1)]}{[(ED \sin(180 - B_2)) + (BC \sin(B_1))]}$$

Second:

Applying the force balance with a respect of the rotational velocity that would happens when applying the force F_1 on the handle AB. Both the point D and E are moving which leads to a linear velocity in the pushing bar EG to push the clips forward to the jaw pair.

The force balance in the structure will be as the following:

$$F_1 \cos(180 - B_2) = F_2 \cos(B_1)$$

$$\text{then the applied force } F_1 = \frac{F_2 \cos(B_1)}{\cos(180 - B_2)}$$

Third:

From the two questions of the free body diagram of the conceptual picture, the parameters that my team members should consider when designing the instrument are lengths of AB, BC, ED, Angles B1, and B2. Assuming that F1 is four ponds to have a pushing force of 20 ponds to close the pairs.

6- CONCLUSION

This paper was focused a new endoscopic surgical instrument design by using CAD program and calculations to find the best geometry of the device to be comfortable in use by the surgeon. CAD program and calculation can benefit geometrical, and dynamical analysis in conceptual and feasible design of biomedical and surgical instruments. The geometric, dynamical and visual limitations of the surgical instruments are analyzed to assist the surgeon in surgical procedure. The analysis of structure in mechanism can provide a systematic and general approach to determine and calculate mechanism motion functionality. The dynamic simulation of these multiple link system permits conceptual verification and feasible studies in the design and development step. Biomedical engineering has gave many important things to develop this device, such as accuracy and good work. Also, surgical operations have become easy and it does not cause syndrome of patient.

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