Design of Plastic Handle for Surgical Applications

Syed Moizuddin, Nawaz Baig, Shaikh Subuktageen

Abstract: ***The paper explains a clip mechanism handle to use for surgical procedures which uses metal clips via a mechanism to transmit the motion from the handle to the jaw at one end which helps inserting the metal clip to patient's vessel. With development in technology; this handle does not operate on a spring mechanism hence it operates in steps, instead of direct and quick movement of arms handle. This also reduces the force required to operate the handle and is better controlled. The rubber grip and ergonomics of the component are carefully selected keeping the operation and use in mind. The delivery mechanism also gets changed than the normal used mechanisms. With the inward movement of the handles, the jaw is moved in inward direction and vice versa. After the jaw is opened, the metal clip is pushed into the tissue for binding the tissues. This ends the operation of the equipment.*** [1, 2, 4, 5]

Keywords—clip mechanism, force required

I. INTRODUCTION

During operations, it is of great importance to bind the tissues or vessels in minimum possible time. So the instrument used should be highly reliable yet effective as even minimum error cannot be tolerated in case of surgical operations. Usually when the plastic handles are closed, the jaw pair are closed which binds the tissue/vessel and the bleeding stops. As soon as the handles are released, the metal clip is pushed towards the joint which seals the torn tissues. [1, 2, 5, 6]

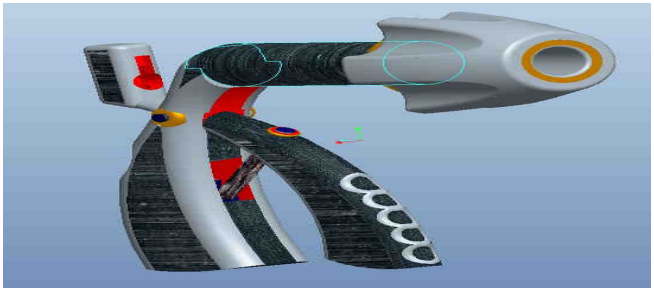

Fig. 1. Assembly of the plastic handle design

With the study of few operations performed using same kind of instruments, a common problem of clip getting shot without even the jaw closing the bleeding portion occurred. In this case, the jaw operated suddenly even damaging the tissue abruptly. This is mainly caused due to use of spring for compression action, and no proper dimension tolerance for the delivery tube mechanism. The action of loading the metal chips also depends mainly on the control of the plastic handle. If the spring used for handles is too stiff, it causes slow motion of the jaw pair and no shooting of clips from the jaw pair.

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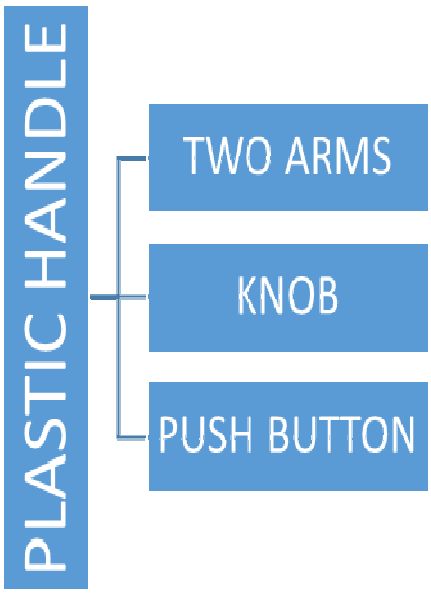
If the spring is less stiff, it causes sudden movement of handles resulting in sudden injection of the metal surgical chips. So for using a compression spring means having a highly precise spring with a very smooth surface finish and exact dimensions which ultimately increases the manufacturing costs and is not reliable. [1, 4, 5, 6] Instead of using a spring, this design involves using discrete steps which is used to control the movement of the handles. As the figure shows, the discrete steps help to lock the bar of second handle which can be pushed left or right on will in discrete steps and not too sudden nor too slow which helps to guide the jaw pair properly.

II. CONSTRUCTION AND WORKING

In this new design, the working of the handles is completely different from the traditional used instruments. Basically the plastic handle consists of three major portions;



A. Two arms and push button:

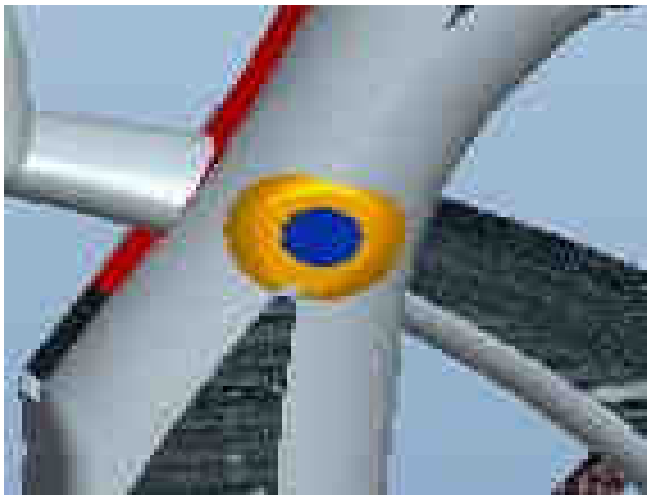


Fig. 2. The push button for the handle movement

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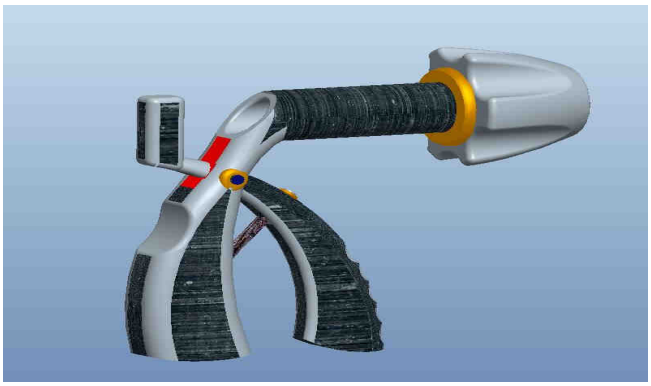

Fig. 3. The push button along with the handles

The two arms are interconnected to each other through the push button. For operating the handle, the push button is to be pushed, then push the right handle upwards which comes in contact with the delivery shaft. The delivery shaft is connected to the jaw at the end. Once the shaft is set inside the big dome slot given in the second handle top end as shown in the figure, the push button is then released and the delivery shaft is set in its locked position. After the proper alignment of the delivery shaft in the slot, the jaw can move accordingly to the proper movement of the handle. Also in the design, the delivery system is completely different from the system traditionally used. After the operator brings the handle pair together, the delivery tube gets activated which are paired with jaws which in turn activates the jaw mechanism. When the operator releases the handles, the clip mechanism returns to its original position and sets up the next clip. Because of the new design of the handles without any use of spring whatsoever, the handles and hence the jaws are better controlled and are more reliable than the original designs.

Fig. 4. The slot provided for fitting of the delivery shaft

B. The knob and the hatchet of the handles:

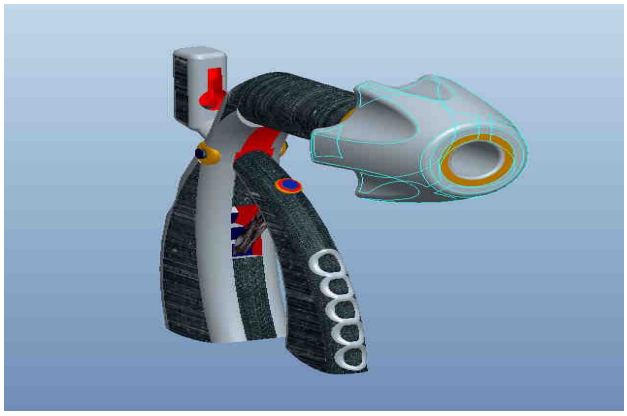

Fig. 5. The knob along with the handle

The knob is the round section fitted at the rod extension for the delivery shaft. As soon as the knob is pushed through the proper ergonomic design slots given, the ring section inside the knob opens in a manner to accept the delivery shaft. The delivery shaft is then connected to the provided slots at the handle endings. As soon as the delivery shaft is fitted in its proper place, the knob is released which locks the delivery shaft at its desired location. The knob can be rotated which in turn is used for rotating the jaw system to an angle required.

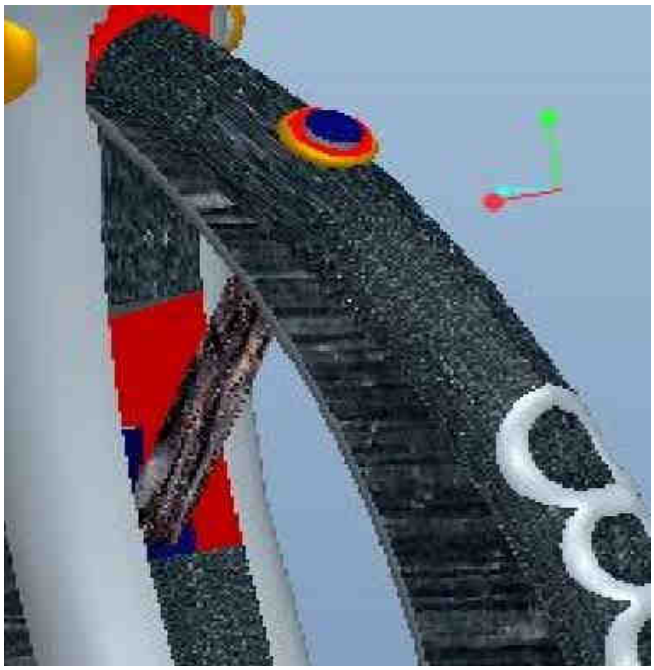

Fig. 6. The hatchet of the handles

The hatchet is the section provided at both the handles which leads to proper movement and control of the handles. The hatched section groove is provided in the left section handle in which the supporting rod from the right handle takes steps. For its operation, the push button at the curved surface of the right handle is pushed and the handle is pushed to its required position. Then the push button is released which in turn locks the handle in each other at the desired location. This gives better control and reliability of the equipment as the force is first applied at the handles to bring the handles or the jaw at the required position then as soon as the push button is released, the handles are locked into each other and the force required to hold the handles is no more required. This also ensures the precision of the instrument.

Two major functions of the knob are as follows;

1. To guide the delivery shaft properly into the slots in the left handle.
2. To lock the delivery shaft into the slots for smooth operation of the jaw.

C. Ergonomics of the designed handles:

The ergonomics of the design is an important factor to be considered for the smooth operation of a design. For the instrument, two basic ergonomics conditions were required at the design phase.

1. Ergonomics of the handles and the knob-

Slots for proper fitting of the four fingers on the right handle and one thumb on the left handle is provided for better grip of the handles. Also slots are provided on the knob for better grip of the knob during pulling and pushing of the knob.

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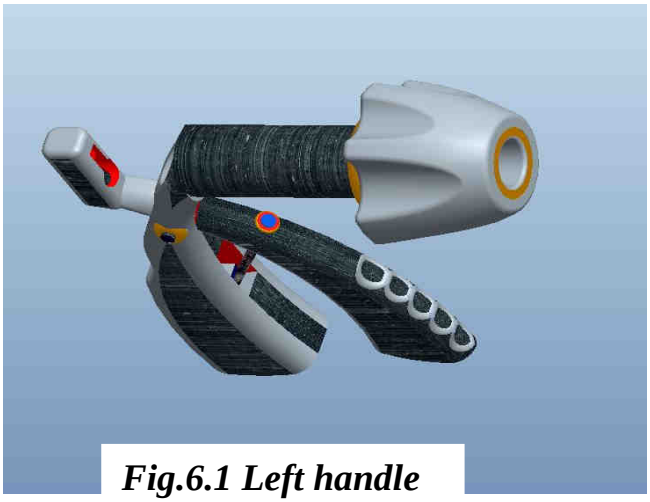

Fig. 7. The slot on the knob

III. FUTURE SCOPE

The major advancement that can be done in the product design and implementation use are as follows;

1. Improving the design of the delivery mechanism which can provide fast and accurate movement of the jaw pair based on handle movements.
2. Even still improving the design to control the action of the handles and ultimately the jaw pair and chip injection.
3. Improving the design of the jaw pair mechanisms twisting conditions which may act due to unpresented loads acting on the jaw pair.
4. Avoiding certain advanced features or supports which may prevent accidental or sudden closing of the jaw pair.
5. Determination of loads and forces acting on the jaw pair for accurate alignment of the jaw pair and handle mechanism.
6. Improving the design of the handle which accepts the smaller dome of the delivery mechanism.

IV. CONCLUSION

The basic function of using the mentioned design is reliability factor and proper functioning of the instrument. This is highly achieved by the new and modified design. The problem of sudden clip injection is minimized in this design, with increasing the efficiency and the reliability of the equipment. Also with the new design handle, the operational force required is less than the traditional designs. We have also focused on improving the performance of the equipment which can be tested after proper use of the designed equipment.

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