Minimising in minimally invasive surgery through the use of a novel and flexible super elastic titanium needle suitable for a 3.5- and 5-mm trocar

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Abstract

The use of smaller ports in surgery is the next step in the evolution of minimally invasive procedures. We present findings, using a novel flexible needle made from a super elastic titanium alloy, which demonstrate that it is possible for a 26- and 30-mm needle to pass through a 3.5- and 5-mm trocar. This new approach results in less trauma and improved cosmetic effect in comparison to the classical 10-mm port. Traditional steps such as handling of the needle holders, loading the needle and placing it at the correct angle and direction, inserting the needle into the tissue and finally safely tying a knot remain the same as with the standard procedure. We propose that this improved type of needle creates a refinement opportunity to replace the classic ones during both laparoscopic and robotic surgeries.

Keywords: Laparoscopic suturing, minimally invasive, needle

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Submitted: 10-Mar-2021, Revised: 14-Apr-2021, Accepted: 27-Apr-2021, Published: 09-Jun-2021

INTRODUCTION

A key advantage of laparoscopic surgery is to improve patients' recovery by minimising abdominal wall trauma. In this regard, the use of smaller ports and instruments is the natural course of evolution of minimally invasive surgery.[¹]

Laparoscopic suturing remains indispensable for the execution of surgical procedures in the gastrointestinal tract.[²] Passing a metal needle through a 3.5- and 5-mm trocar instead of the standard 10-mm trocar represents a further evolution of laparoscopic surgery.

We describe here the use of a novel flexible needle, made from a super-elastic titanium alloy, which allows extreme flexibility and elastic deformation so that the 26- and 30-mm needle can pass through a 3.5- and 5-mm trocar (JOST, Belgrade, Serbia). This results in a reduction in trauma to the anterior abdominal wall in comparison with a classic 10-mm trocar, and there is also an improved final cosmetic effect.

OUR MODIFICATION

The patient in this case gave informed consent and his/her anonymity remained preserved.
We used 2-0 Polydioxanone (JOST PDO, Belgrade, Serbia). The novel needle was made out of titanium alloy Nitinol. It was certified by SZUTEST (the accredited body by European commission for the certification of medical equipment - CE sign for medical devices class III). Type of needle used was Tapper point, with the curvature of $\frac{1}{2}$ (1/2 circle) and the length of 26 mm.

When inserting the needle into the 3.5- and 5-mm trocar, it was necessary to hold the needle by its metal part and not the thread. Inserting the needle through the 3.5-mm trocar was simple and done in one single action [Figure 1a and b].

Handling the needle holders, loading the needle into its holder, placing it at the correct angle and direction, making an incision into the tissue and finally safely tying the knot were exactly the same as with the standard needle. Here, we present the outcomes using the needle for suturing of a perforated duodenal ulcer [Figure 2]. The final cosmetic effect was also improved in comparison to the standard procedure [Figure 3].

**DISCUSSION/BENEFITS**

Laparoscopic intracorporeal suturing is one of the most difficult procedures in laparoscopic surgery. Suturing and knot tying using the needle with thread continue to be an essential part of all laparoscopic gastrointestinal operations. It requires a 10-mm trocar as a standard.

Whilst it has been described previously that the use of the Clarke ligator (the instrument, knot-pusher) allows for a simpler method in laparoscopic suturing, allowing any size curved needle to be inserted through a 5-mm puncture site, we present here that our novel, super-elastic titanium alloy needle provides flexibility and the ability of the needle to pass through a 3.5- and 5-mm trocar, without any additional instrumentation.

The length of the needle can be variable, for example 26 or 30 mm, and can pass through a 3.5-mm and/or 5-mm trocar. Curvature of the needle is $\frac{1}{2}$ (1/2 circle); however, the degree of the curvature is not associated with passing of the needle through the trocar. This is because the alloy itself is so elastic (bendy), allowing the passage of the needle despite of its curvature. In addition, the operator can arrange the desired form during suturing, and the needle will return to its normal shape, without compromising its sharpness.

The cost of JOST PGLA (Belgrade, Serbia) or JOST PDO (polydioxanone) is 12.95 Euros. The price is 20%–50% higher than other brands currently used. However, if this type of needle was to gain wider acceptance and usage by the surgical teams in different countries, we could expect the price to drop significantly.

Importantly, this method of suturing is also cheaper (more affordable) overall if we compare this method with the Clarke one because it does not require additional instrumentation, thus improving its efficiency.

Minimisation of the trauma to the anterior abdominal wall or the thorax can be achieved by minimising the size of the

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*Figure 1: (a and b) Inserting the needle into a 3.5-mm trocar and removing the needle*

*Figure 2: The needle and the needle holder whilst suturing a duodenal ulcer*

*Figure 3: The final cosmetic effect*
The skin incision is smaller in comparison to the use of the standard 10-mm trocar. We also speculate that the post-operative pain may be reduced, because, for example, patients who underwent laparoscopic cholecystectomy with three 5-ram ports had, on average, less incisional pain, spent fewer days on pain medication and took fewer prescription pain relief tablets than patients who underwent the same procedure with standard sized trocars, with two 10-ram ports and one 5-ram port. There is also an association between reduced laparoscopy incisions and reduced pain sensation.

Naturally, any effort to reduce invasiveness and improve cosmesis of laparoscopic surgery must not jeopardise safety. The manufacturer currently produces 2-0 and 3-0 polydioxanone and polyglycolide threads. These can be used for most procedures in the abdomen and thorax.

During robotic surgery, there is a trend towards reducing trocar size from 8 to 5 mm and even 3 mm. The presentation of our novel needle presents an opportunity towards the refinement and minimisation of the diameter of the trocar. We propose that the use of a flexible needle, such as the one described in this report, presents both a refinement and an opportunity for implementation in both laparoscopic surgery and robotic surgery.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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