



Articulating laparoscopic instruments: are they a breakthrough that can overcome current limitations in laparoscopic gastric cancer surgery?

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Laparoscopic surgery is rapidly evolving with technological advances, but there are several drawbacks. An articulating device, with freedom of a perfect 360°, is attractive as a solution to overcome the restriction of instrument movement caused by straight tools. Its usefulness or efficacy should be supported by relevant scientific evidence. However, it is sometimes difficult to prove it because the factors influencing the surgical outcomes are complex and closely related to each other.

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Laparoscopic surgery has become a standard procedure in patients with gastric cancer. Its oncological safety has been demonstrated in pivotal clinical trials, such as the KLASS-01 and KLASS-02 trials of the Korean Laparoendoscopic Gastrointestinal Surgery Study (KLASS) Group, and it has shown clinical benefits, such as earlier recovery and fewer postoperative complications, when compared with open gastrectomy [1–3]. Laparoscopic methods are currently utilized in patients with advanced-stage tumors and in technically demanding and complicated procedures such as pylorus-preserving gastrectomy. Important clinical trials are currently assessing the use of laparoscopic surgery for gastric cancer. For example, the KLASS-06 phase III trial is evaluating the oncological safety of laparoscopic total gastrectomy in patients with upper third gastric cancer.

Laparoscopic surgery has evolved with technological advances

in laparoscopic instruments, imaging systems, and energy devices. Although these advances have made laparoscopic surgery more efficacious and easier, these surgical methods still have several drawbacks. These include the optical limitations (e.g., color, resolution) of current laparoscopic imaging systems; the lack of tactile sensation; and limitations in movement due to the nature of rigid laparoscopic instruments. Although these shortcomings were markedly alleviated by the advent of robotic surgical systems, a phase II trial found that robotic surgery did not improve surgical outcomes in patients undergoing distal gastrectomy for gastric cancer [4]. In addition, the high cost of robotic systems limits their wide-spread application in various surgical fields, especially in developing countries. Recently, the distinct advantages of robotic surgical systems have been applied to laparoscopic systems, including three-dimensional visualization, near-

infrared fluorescence imaging technology, and an articulating grasper or needle holders.

In this issue of *Journal of Minimally Invasive Surgery*, Lee et al. [5] firstly tried to evaluate the usefulness of a novel articulating instrument, ‘ArtiSential’ (Livsmed, Seongnam, Korea), in laparoscopic gastric cancer surgery. Surgical outcomes have been compared in 180 patients who underwent laparoscopic gastrectomy using robotic-like ArtiSential wristed devices and 147 patients who underwent conventional laparoscopic gastrectomy. Following 1:1 propensity score matching to reduce selection bias, the two groups showed similar operative outcomes, including operation times ($p = 0.846$) and postoperative complications ($p = 0.656$). Blood loss tended to be lower in the ArtiSential group, but the difference was not statistically significant even after propensity score matching (28.1 mL vs. 46.7 mL, $p = 0.066$). Interestingly, no definite learning curve for the articulating device was observed in the ArtiSential group. These results indicate that the use of articulating instruments may be safe and feasible, without increasing operation time or intraoperative/postoperative complications, and does not require a steep learning curve. However, the new articulating device did not improve surgical performance in this

study, a finding that may have been due to the heterogeneity of surgical procedures, including type of gastrectomy and extent of lymph node dissection. More robust studies may therefore be required to clarify the efficacy of these new articulating devices in gastric cancer surgery.

This study raised several interesting issues. First, the findings of this study may indicate situations in which the use of articulating instruments during laparoscopic surgery may be most helpful. Handling of current articulating instruments is uncomfortable, as these instruments are larger in size than conventional rigid instruments and require excessive wrist twisting to manipulate. Wrist stress can occur because the jog controller setting is set to the forearm axis, whereas the hand naturally faces toward the center of the body. A comparison of wrist postures required to grasp each instrument comfortably showed that wrists are more twisted when grasping ArtiSential than other devices (Fig. 1). Other possible cause of wrist stress is the fulcrum effect, which depends on target distance and trocar placement. Operation on a distant target from the working port requires wrist extension, whereas operation on a nearby target may require wrist flexion. Similar phenomena may depend on

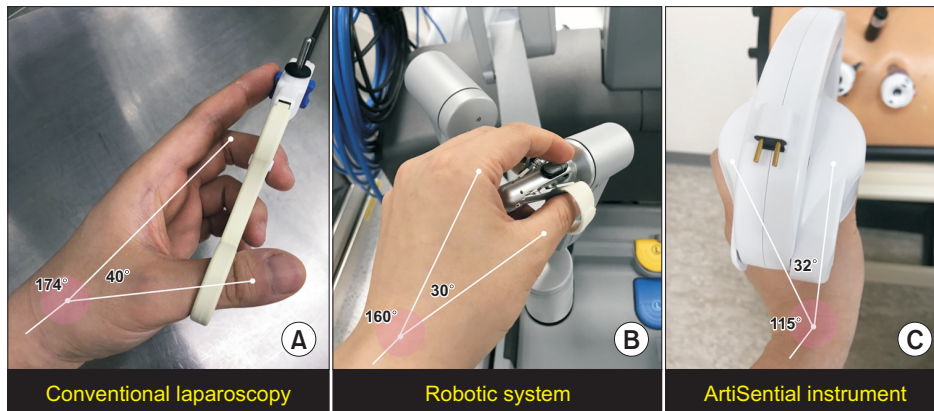


Fig. 1. Wrist ergonomics when grasping the instrument handles in (A) conventional laparoscopy, (B) robotic surgery, and (C) the ArtiSential instrument (Livsmed, Seongnam, Korea).

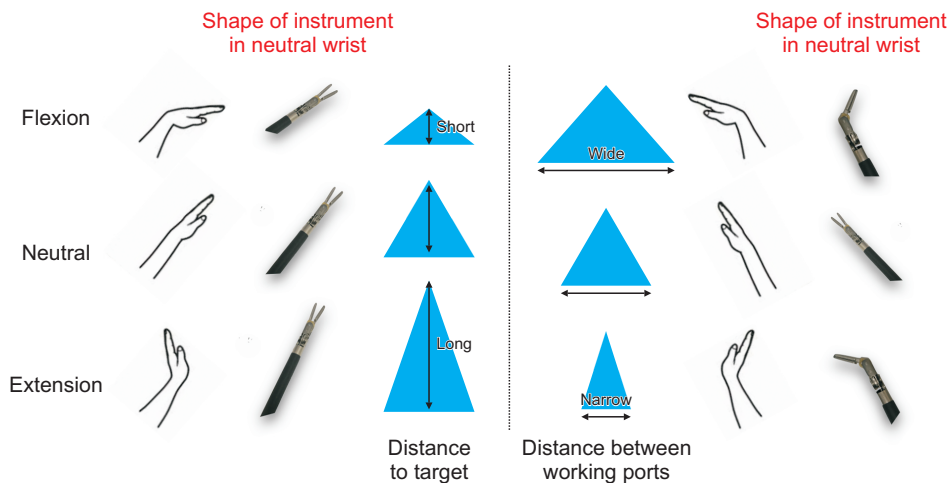


Fig. 2. Relationships of wrist posture with target distance and trocar placement.

the distance between the two working ports (Fig. 2). The use of currently available instruments in all surgical procedures may be complicated and inefficient, whereas selective and temporary use of devices may be helpful in dissecting #11p or splenic hilar nodes that require vertical traction.

Another important issue is the cost-effectiveness of articulating instruments. Robotic distal gastrectomy requires longer operation times, even after the long-term experience, and is associated with an average in-hospital charge about 1.5 times higher than laparoscopic distal gastrectomy [4,6]. However, robotic distal gastrectomy did not show clear clinical benefits when compared with laparoscopic distal gastrectomy. The single-use, reasonably priced ArtiSential instrument was developed to reproduce the advantages of the robotic arm in laparoscopic surgery. This novel articulating instrument may be an excellent alternative to robotic surgical systems, with the same clinical benefit but reduced overall operation time and in-hospital cost.

In summary, this study demonstrated that the use of this novel articulating device was feasible in laparoscopic gastric cancer surgery. More robust studies are needed to determine the usefulness of this instrument for certain indications. Better articulating devices may overcome the limitations of current devices for laparoscopic surgery.

NOTES

Authors' contributions

Conceptualization: SYS, HH

Investigation: SYS, SUH

Methodology: SYS, CKR

Visualization: SYS

Writing—original draft: SYS

Writing—review & editing: All authors

All authors read and approved the final manuscript.

Conflict of interest

The authors have no conflicts of interest to declare.

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