VIDEO/MULTIMEDIA ARTICLE

pISSN 2234-778X • eISSN 2234-5248
J Minim Invasive Surg 2022;25(4):161-164

JMIS Journal of Minimally Invasive Surgery

Usefulness of the new articulating laparoscopic instrument in laparoscopic pancreaticoduodenectomy

Sung Hoon Choi

Division of Hepatobiliary and Pancreas, Department of Surgery, CHA Bundang Medical Center, CHA University, Seongnam, Korea

Minimally invasive pancreaticoduodenectomy has been developed in two tracts of robotic and laparoscopic surgeries. Laparoscopic approach remains a frequently performed surgical method that accounts for a significant portion of minimally invasive pancreaticoduodenectomy. However, biliary and pancreatic reconstruction stages are still demanding procedures because of the inherent limitations of conventional laparoscopic instruments. Therefore, recently developed articulating laparoscopic instruments have greater dexterity similar to robotic instruments seem to be able to compensate for the weak points of conventional laparoscopic instruments. In this article, we demonstrate the hepaticojejunostomy and duct-to-mucosa pancreaticojejunostomy technique using the new articulating laparoscopic instrument.

Keywords: Laparoscopy, Pancreaticoduodenectomy, Pancreatectomy, Pancreaticojejunostomy

Received August 30, 2022
Revised September 30, 2022
Accepted November 17, 2022

Corresponding author
Sung Hoon Choi
Division of Hepatobiliary and Pancreas, Department of Surgery, CHA Bundang Medical Center, CHA University College of Medicine, CHA Global Clinical Trials Center
Building #417, 64 Yatap-ro, Bundang-gu, Seongnam 13496, Korea
Tel: +82-31-780-1824
Fax: +82-31-780-5259
E-mail: feel415@cha.ac.kr
ORCID:
https://orcid.org/0000-0002-1664-3727

INTRODUCTION

Minimally invasive pancreaticoduodenectomy (MIPD) procedures have been performed by several expert surgeons, and their safety and feasibility have been demonstrated [1–3]. However, it is far from commonly used surgical method. Difficulty of biliary and pancreatic reconstructions are the main obstacles for MIPD. Robotic surgery has been shown to be superior to conventional laparoscopic surgery in reconstruction procedures [4,5]. However, the high cost of robotic surgery has impeded propagation of its application, and the laparoscopic technique remains a frequently performed surgical method that accounts for a significant portion of MIPD [4]. Recently, new laparoscopic articulating instruments have been developed to ameliorate the conventional laparoscopic instruments [6]. This article demonstrated how the new articulating laparoscopic instrument can overcome the limitation of a conventional straight laparoscopic instrument for hepaticojejunostomy and pancreaticojejunostomy in laparoscopic pancreaticoduodenectomy (LPD).

METHODS

A 76-year-old male with an ampulla of Vater cancer underwent LPD. His body mass index was 23.88 kg/m^2 and the American Society of Anesthesiology physical status grade was III.

The new laparoscopic articulating instruments (ArtiSential;

LIVSMED Inc., Seongnam, Korea) have an 8-mm-sized shaft and provide 360° of free motion of the end-effector as robotic surgery by controlling two pinching triggers on the handle.

The patient's position for our LPD is supine on the table. We use three 12-mm trocars and two 5-mm trocars for LPD (Fig. 1). Positioning of the three 12-mm ports is most important and forms an ecliptic line with respect to the umbilicus, as in robotic surgery. This port placement is identical in LPD and robotic pancreaticoduodenectomy (RPD) and is appropriate for use of articulating instruments. The operator and scopist both stand at the left side and the assistant surgeon stands at the right side of the patient during the entire procedure except during resection of the uncinate process [7].

We prefer conventional straight laparoscopic instruments in the resection phase because those can cover all the resection procedures and are easier to control. The articulating instruments perform best in the reconstruction phase and mainly use an articulating needle driver (Fig. 2) to pursue the demanding biliary and pancreatic reconstruction through the left-side 12-mm trocar using a surgeon's dominant right hand (Supplementary Video 1). Meanwhile, the surgeon's left hand uses conventional laparoscopic instruments through the right-side 12-mm trocar. We performed pancreaticojejunostomy in the form of end-to-side anastomosis. A duct-to-mucosa anastomosis was carried out by interrupted absorbable monofilament suture (PDS 5-0; Ethicon, Somerville, NJ, USA) with an internal short silicone catheter, while the outer layer was sutured by interrupted nonabsorbable monofilament (Prolene, Ethicon) between the edges of pancreatic cut surface and seromuscular layer of the jejunal wall. The hepaticojejunostomy was made by continuous absorbable barbed

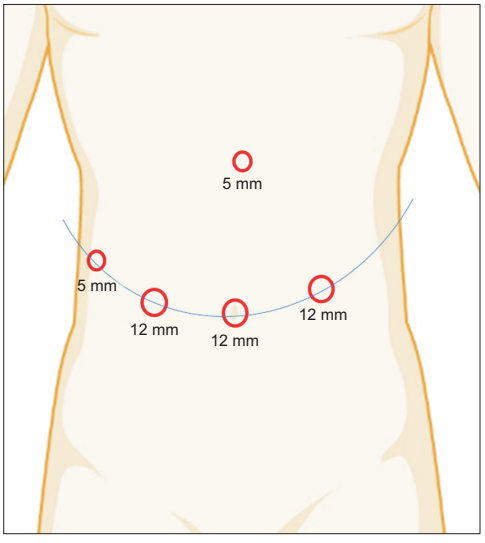

Fig. 1. Port placement. Three 12-mm ports are placed in an ecliptic line with respect to the umbilicus, as in robotic surgery.

Fig. 3. Operative settings during the reconstruction phase. We use a laparoscope holder during the reconstruction stage for a stable operative view. The surgeon uses the laparoscopic articulating needle driver on the right hand and the conventional laparoscopic instruments on the left hand in the sitting position.

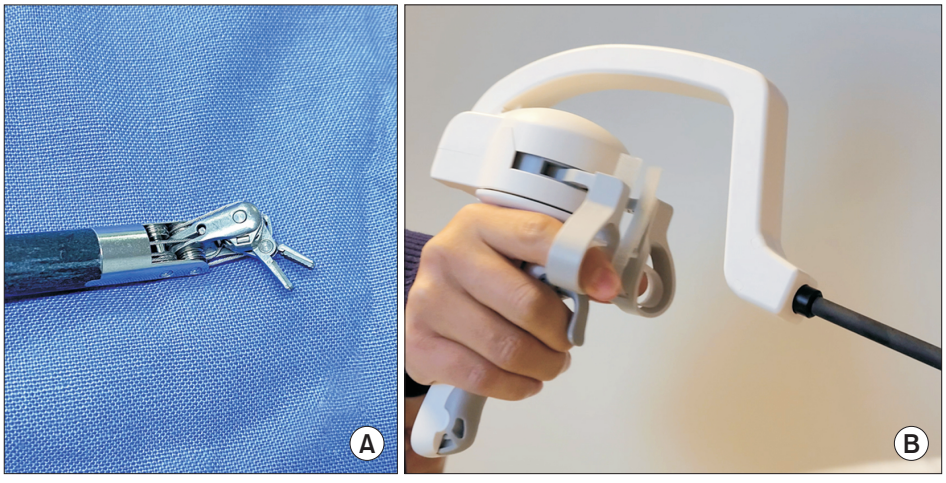

Fig. 2. Laparoscopic articulating needle driver. The articulating needle driver provides 360° of free motion of the end-effector (A) as robot surgery by controlling two pinching triggers on the handle (B).

suture (Stratafix 5-0, Ethicon) for posterior wall and interrupted absorbable monofilament suture (PDS 5-0) for anterior wall.

During the reconstruction stage, the operative field is fixed and does not need to move. Therefore, we apply a laparoscope holder in this stage to allow the assistants to rest and to procure a stable operative view. In addition, the surgeon can execute the procedures in a sitting position (Fig. 3).

RESULTS

In this video, we demonstrate the hepaticojejunostomy and duct-to-mucosa pancreaticojejunostomy technique using the articulating laparoscopic instrument. The total operative time and the amount of blood loss were 390 minutes and 170 mL. The patient had a pancreatic biochemical leak and no specific complication, but he was discharged on the 14th postoperative day because of slow recovery due to poor general condition.

DISCUSSION

Although RPD offers theoretical advantages to conventional LPD, there are still controversies about the real benefits of RPD [8]. Therefore, surgeons use heterogenous MIPD techniques including laparoscopic, robotic, and combined approaches [4]. However, reconstruction stage in PD requires high-level expertise and is associated strongly with postoperative morbidities. In particular, pancreatic reconstruction is a demanding procedure because of the texture of the pancreas parenchyma, which is difficult to manipulate; the small diameter of the pancreatic duct; and the nature of the pancreas as a three-dimensional solid organ that requires multidirectional sutures. In addition, conventional straight laparoscopic instruments have inherent limitations for such delicate procedures. Although the robotic approach could be a good alternative option, RPD is considered to still be in its infancy and performed exclusively in high-volume centers. Overall, more LPDs have been performed worldwide compared with LPDs [9].

Laparoscopic surgery also has some advantages including various applicable instruments, fast change of instruments during the procedure, and cost-effectiveness compared to robotic surgery. Therefore, if any mechanical improvement of the laparoscopic instrument could help to compensate for the weak points of conventional laparoscopic instruments, LPD would still be a good option for MIPD.

Although various articulating laparoscopic instruments have been introduced, most of them are not well developed. Meanwhile, recently developed articulating laparoscopic instruments introduced in this article have greater dexterity and can be synchronized with the surgeon's hand motions, similar to robotic instruments. Jin et al. [6,10]. introduced the clinical usefulness of this new laparoscopic multi-joint articulating instruments in single-incision laparoscopic surgery and colorectal surgery. Nevertheless, these articulating instruments have not been popularized because of some limitations including a relatively long learning curve and a physical burden in operating the new instruments. Surgeons have to use extra muscles and effort to control it, which is definitely harder than robotic surgery and even conventional laparoscopic. Therefore, it is essential for surgeons to practice using the training kits to become skilled and accustomed to the coordination between the surgeon's hand motion and the instrument movement. Despite of some drawbacks, this instrument enables the reproduction of almost identical freedom of motion in the effector instrument as a robotic surgical system. In particular, the reconstruction phase has a stable operative field and several challenging angles for anastomosis to be carried out by the conventional straight instrument, which are good indications for the application of this articulating instrument. To the best of our knowledge, current article is the first report that introduces the application of this articulating laparoscopic instrument in the reconstruction procedures during LPD.

In conclusion, a learning curve is necessary for the skillful use of articulating laparoscopic instruments. However, such a fully articulating laparoscopic instrument can help to overcome extremely difficult reconstruction procedures infeasible with conventional laparoscopic instruments.

NOTES

Ethical statements

This study was approved by the Institutional Review Board of CHA University (No. 2022-08-062) and performed in accordance with the ethical standards of institutional research and the Declaration of Helsinki. The need for informed consent in this study was waived, as Korean regulations do not require consent for retrospective analyses.

Conflict of interest

The author has no conflicts of interest to declare.

Funding/support

None.

Acknowledgments

The authors would like to express special thanks to Eui Hyuk Chong (Fellow, Department of surgery, CHA Bundang Medical Center, Seongnam, Korea) for the comprehensive narration of

this multimedia article.

Supplementary materials

Supplementary materials can be found via https://doi.org/10.7602/jmis.2022.25.4.161.

REFERENCES

1. Shin SH, Kim YJ, Song KB, et al. Totally laparoscopic or robot-assisted pancreaticoduodenectomy versus open surgery for periampullary neoplasms: separate systematic reviews and meta-analyses. Surg Endosc 2017;31:3459-3474.
2. Kim H, Choi SH, Jang JY, Choi M, Lee JH, Kang CM. Multicenter comparison of totally laparoscopic and totally robotic pancreaticoduodenectomy: propensity score and learning curve-matching analyses. J Hepatobiliary Pancreat Sci 2022;29:311-321.
3. de Rooij T, Lu MZ, Steen MW, et al. Minimally invasive versus open pancreatoduodenectomy: systematic review and meta-analysis of comparative cohort and registry studies. Ann Surg 2016;264:257-267.
4. Ricci C, Casadei R, Taffurelli G, Pacilio CA, Ricciardiello M, Minni F. Minimally invasive pancreaticoduodenectomy: what is the best "choice"? A systematic review and network meta-analysis of non-randomized comparative studies. World J Surg 2018;42:788-805.
5. Chen S, Chen JZ, Zhan Q, et al. Robot-assisted laparoscopic versus open pancreaticoduodenectomy: a prospective, matched, mid-term follow-up study. Surg Endosc 2015;29:3698-3711.
6. Jin HY, Lee CS, Lee YS. Laparoscopic extended right hemicolectomy with D3 lymph node dissection using a new articulating instrument. Tech Coloproctol 2021;25:235-237.
7. Choi SH, Chong EH, Jang JY. Self-traction method for uncinate process dissection during laparoscopic pancreaticoduodenectomy. J Gastrointest Surg 2022;26:1547-1549.
8. Kamarajah SK, Bundred J, Marc OS, et al. Robotic versus conventional laparoscopic pancreaticoduodenectomy a systematic review and meta-analysis. Eur J Surg Oncol 2020;46:6-14.
9. Kabir T, Tan HL, Syn NL, Wu EJ, Kam JH, Goh BKP. Outcomes of laparoscopic, robotic, and open pancreatoduodenectomy: a network meta-analysis of randomized controlled trials and propensity-score matched studies. Surgery 2022;171:476-489.
10. Jin HY, Lee CS, Lee YS. Single incision laparoscopic appendectomy using a new multi-joint articulating instrument. J Gastrointest Surg 2021;25:2437-2438.