

# Handheld articulating laparoscopic instruments driven by robotic technology. First clinical experience in gynecological surgery

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**Abstract** Kymerax, a new robotic-driven, handheld articulating laparoscopic device, that provides improved triangulation while preserving precise motions, has just recently been introduced to the European market. The KYMERAX System consists of a generator, handles, and interchangeable instruments. We describe a case in which KYMERAX was successfully used during a total laparoscopic hysterectomy. A 42-year-old patient (IIG/IIP) presented with a history of hypermenorrhagia and dysmenorrhagia. Because of a prior cesarean section and to rule out further pathologies possibly associated to dysmenorrhagia, the patient was prepared for a total laparoscopic hysterectomy in our department. The world's first human use of the KYMERAX System was discussed in details with the patient prior to the procedure. The first clinical use in gynecologic laparoscopy proved to be feasible with the new robotic-driven, articulating, handheld surgical system. KYMERAX may offer benefits in advanced laparoscopy, NOTES, and single-port surgery.

**Keywords** Motor-driven · Triangulation · Total laparoscopic hysterectomy · KYMERAX · Robotic

## Background

Laparoscopic surgeons have evolved to operate without the flexibility of wrist movements. Compared to daily human manual activities, the conventional laparoscopic instrument, which has an approximate length of 35 cm, offers an active instrument tip for grasping, cutting, dissecting, coagulating tissue, and similar activities which frequently require rotation. However, triangulation or articulation of instrument tips, just as the wrists, was exclusively offered in the overly expensive laparoscopic robotic system, called Da Vinci [1].

A new motor-driven, handheld system that offers precision-driven, articulating instruments, called KYMERAX (Terumo, Japan) has recently been introduced to the medical market in Europe.

The KYMERAX System is comprised of a console, handles, and interchangeable instruments. Up to two handles can be connected to the console, which provides power to the motors located within the handle component of the system. These motors are activated by the user through the manipulation of the buttons and controls of the handle interface, and allows for rotation and yawing motions of the instrument tips (Figs. 1, 2). The motors for the instruments rotation and yawing speed can be adjusted from 1 to 5 (slow to fast) within the console.

The four available instruments attach to the handle component, are 8.8 mm in diameter and include a Monopolar scissors, Maryland dissector, needle driver, and monopolar L-hook.

The Department of Gynecology and Obstetrics at the University Clinic of Giessen, Germany was the second facility to use the KYMERAX System clinically, after the Urology Department at the University of Salzburg, Austria, and was the first facility worldwide to perform a gynecologic case, a total laparoscopic hysterectomy. First clinical

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**Fig. 1** The KYMERAX System is comprised of a console, handles, and interchangeable instruments

experiences and a guide for familiarization with the new motor-driven, articulating instrument system are discussed.

## Method

A 46-year-old patient (IIG/IIP) with known uterine myomas presented with hypermenorrhagia and dysmenorrhagia. Earlier dilatation and curettage revealed no pathologies and hysterectomy was discussed with the patient for treatment. Because of a previous cesarean section, and to rule out further pathologies possibly associated to dysmenorrhagia, the patient was prepared for a total laparoscopic hysterectomy in our department.

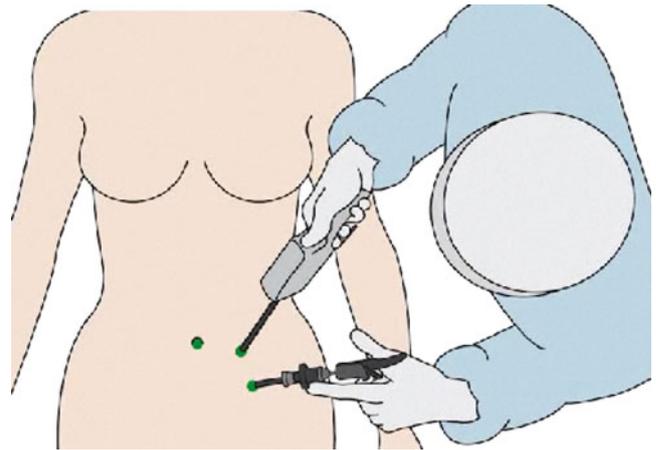
Before the procedure, adequate explanation was given to the patient about the KYMERAX System and its first time use in gynecologic laparoscopy. On the 13th of May, 2011, a total laparoscopic hysterectomy (TLH) was performed at the Department of Gynecology and Obstetrics in Giessen, Germany. Ipsilateral trocar placement was used on the surgeon's side (Fig. 3).

The TLH followed a standardized procedure with following key steps:

1. Sealing and transecting the round ligament
2. Transecting the ovarian ligament and the uterine tube



**Fig. 2** The possible articulated and rotated instrument tip



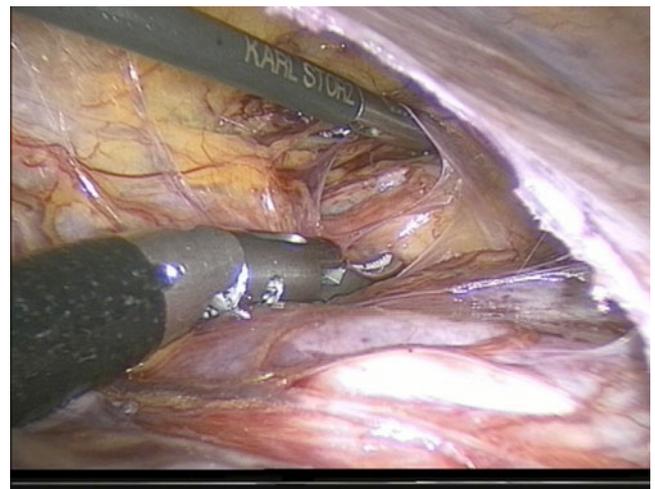
**Fig. 3** The ipsilateral placement of working trocars for the surgeon

3. Dissecting the broad ligament
4. Identifying the ureter (Fig. 4)
5. Exposing and sealing the uterine vessels
6. Skeletonizing the cervix (Fig. 5)
7. Resecting the uterus (Fig. 6)
8. Closing the vaginal cuff (Fig. 7)

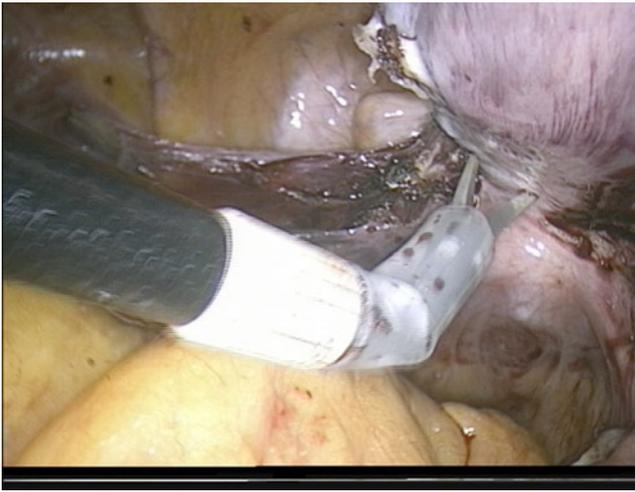
The surgical procedure was performed without any intraoperative complications. Blood loss was <5 ml, surgical time from insertion of the Veres needle to closure of the skin, 90 min. After an uneventful postoperative course, the patient was discharged on postoperative day 3.

## Findings

The first clinical use in gynecological laparoscopy proved to be feasible with the new robotic-driven, articulating



**Fig. 4** The KYMERAX dissector is used to open the retroperitoneum and identify the ureter-uterine crossing

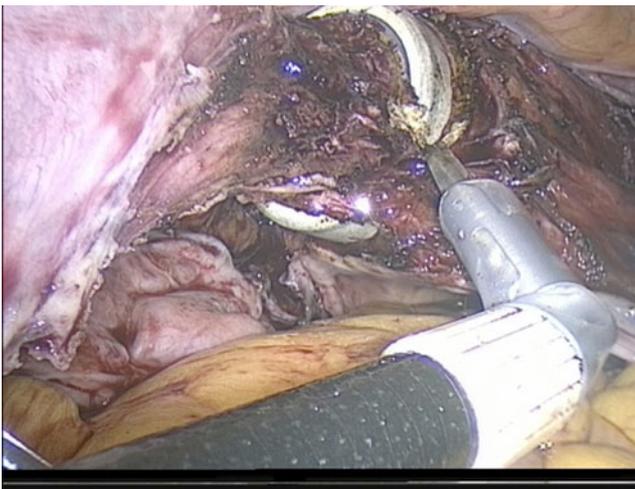


**Fig. 5** The KYMERAX Monopolar Scissors are used for skeletonizing the uterine cervix

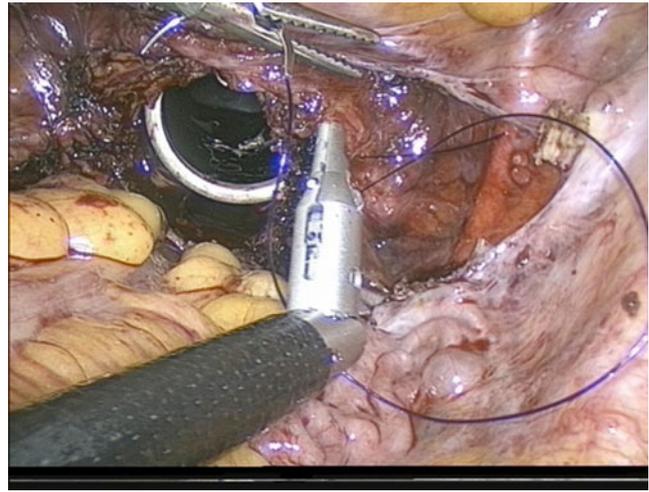
instrument. Ipsilateral trocar placement was confirmed to be especially beneficial, as the articulating tips of the KYMERAX instruments allowed for contralateral dissection of the broad ligament, the skeletonizing of the cervix, and transection and suturing of the vagina. There were no complications and the patient was discharged after an uneventful hospital stay of 3 days.

The idea of angled instruments for laparoscopy is not new [2]. Hand-manipulated angled instruments such as the Realhand or the Radius Surgical System have been proposed earlier, but never entered the market on a wide range [3, 4]. Advanced vision has also been introduced to the market and has shown a variety of possible benefits [5].

Though the KYMERAX System was previously used by the authors AH and MK extensively in bench studies, including animal and cadaver models, the first clinical use brightens the possible benefits. These may include



**Fig. 6** The KYMERAX Monopolar Scissors are used for separating the vaginal cuff



**Fig. 7** The KYMERAX needle driver is used for suturing the vaginal cuff

more precise dissecting abilities while tissue can be manipulated three dimensionally, ease in identifying and dissecting hard to reach structures and compartments with reduction of tissue trauma, advancing suture techniques within a limited space, possible reduction of shoulder strain experienced by the surgeon through ipsilateral trocar placement, and reduced number of abdominal incisions. Compared to other full robotic consoles, KYMERAX seems to be reasonably priced, therefore allowing for a wider spread distribution.

However, as with all highly advanced new technical equipment, novices will experience a steeper learning curve when adapting to the articulation. The use of buttons placed on the instrument's handle to drive the tip, requires familiarization. To increase patient safety and to reduce surgeon's efforts, a standardized curriculum for getting acquainted with the advances of triangulation should be mandatory for new users of the KYMERAX System. This may also reduce difficulties in directing the tip and support effectiveness of using the articulating branches.

Nowadays, surgeons have adapted to the drawbacks of conventional laparoscopy, such as limited maneuverability and two-dimensional vision, but are still able to perform highly advanced surgical procedures, such as pelvic and paraaortic lymphadenectomies. Patients requiring highly advanced surgical procedures, as well as those with procedures requiring extensive suturing (i.e., myomectomy, sacrocolpopexy), may benefit from a more precise and possibly faster surgery. Also, the surgeon may benefit, as shoulder and elbow strain may be reduced, when utilizing more comfortable and ergonomic trocar placement. This better trocar placement is the result of a shift of triangulation from the surgeon's upper extremities to the tip of the instrument.

## Conclusion

KYMERAX, the new handheld robotic-driven technology with articulating instrument tips, is a long awaited development for minimally invasive surgery. This innovative device offers a path-breaking alternative between conventional laparoscopic surgery and the unrivaled Da Vinci Robotic system. Further clinical use and adequate clinical studies are necessary to highlight the instrument benefits. Independent from that, the uniqueness of allowing the surgeon to use his/her “wrist,” offers a benefit that overcomes one of the major drawbacks of laparoscopic surgery.

**Declaration of interest** A. Hackethal and M. Koppan were actively involved in the development of KYMERAX as consultants for Terumo, Japan and received consulting fees or honoraria.

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