

Laparoscopic gynaecological surgery

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Abstract

Surgical technology has advanced to a level where most gynaecological operations can be performed laparoscopically. Performing laparoscopic surgery requires a degree of surgical skill and structured training is required. A mixture of simulation training and supervised clinical training is required to acquire the skills to perform laparoscopic surgery competently. Attending good quality training courses will enhance the required skills and allow practice of these procedures before attempting these procedures on patients. A patient-centred approach should be adopted when counselling patients pre-operatively, particularly when choosing the route of a procedure. Structured training in technical and non-technical skills is essential.

Keywords consent; electrosurgery; ergonomics; gynaecology; hysterectomy; laparoscopic surgery; laparoscopy; simulation; training

Introduction

Technology has advanced to a level where most gynaecological operations can be performed laparoscopically. Such procedures include hysterectomy, surgical management of ectopic pregnancy, oophorectomy, ovarian cystectomy, excision of endometriosis, sterilisation and its reversal, myomectomy, colposuspension and sacrocolpopexy.

Performing laparoscopic surgery requires a degree of surgical skill and structured training is required. Due to the reduction in working hours of specialty trainees, it is an increasing challenge to train sufficiently in gynaecological surgery. Attending good quality training courses will enhance the required skills and allow practice of these procedures before attempting these procedures on patients.

Laparoscopy versus vaginal and open surgery

Benefits

Laparoscopic surgery confers many advantages over open surgery. Patients undergoing laparoscopic surgery experience a

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quicker post-operative recovery, fewer febrile episodes and fewer wound/abdominal wall infections. Patients also have less pain postoperatively and have a shorter hospital stay. Women having laparoscopic surgery return to normal activities faster and their quality of life at 6 weeks postoperatively has been found to be better with laparoscopic as compared to open surgery.

There is a fine balance between the cost effectiveness of laparoscopic versus open surgery, and this is likely to be because of the prolonged operating time and use of disposable instruments at laparoscopy.

Risks

As with any surgery, there are risks associated with laparoscopic surgery. The Royal College of Obstetricians and Gynaecologists provides guidance on how to present risk to a patient during a consent consultation (see [Table 1](#)).

The overall risk of serious complications at laparoscopy is 2 in 1000. This encompasses risk of injury to bladder, bowel, uterus, ureters and major blood vessels, which would lead to repair of injury laparoscopically or can lead to a laparotomy. However, 15% of bowel injuries may not be identified at the time of initial laparoscopic procedure. Other serious risks include: failed primary port entry, leading to inability to carry out the intended procedure, hernia at the port sites, venous thromboembolism and death.

Frequent risks include: bruising, shoulder tip pain, wound gaping and infection.

Additional procedures may also be required at the time of surgery and should be discussed with the patient. These include: laparotomy, repair of any injury and blood transfusion.

There are specific procedure-related risks that should also be considered.

Sterilisation can fail resulting in an unplanned pregnancy. Regret is common when sterilisation is performed under the age of 30 years.

The management of an ectopic pregnancy can result in persistent trophoblastic tissue, salpingectomy (if salpingotomy planned) and oophorectomy. Further details of risks of these procedures are summarised in [Table 2](#).

Anaesthetic risks should also be discussed by the anaesthetist, particularly in high risk patients. Operating times are longer and adequately ventilating the patient can be a challenge for the anaesthetist due to the pneumoperitoneum, particularly in obese patients or those with underlying lung disease.

Complication rates

Obese patients should be informed that complication rates will be higher than stated in the tables below.

Urinary tract injuries occur more often in laparoscopic procedures, particularly when comparing laparoscopic, vaginal and open hysterectomy. Laparoscopic surgery also results in longer operating times.

When comparing vaginal hysterectomy with the laparoscopic approach, the vaginal route is found to be superior since it is associated with the fastest return to normal activities and shortest hospital stay. Furthermore, vaginal hysterectomy had the shortest operation time, lower use of oral analgesia on day two postoperatively and lower hospital costs compared to both laparoscopic and abdominal hysterectomy.

Presenting information on risk

Term	Equivalent numerical ratio	Colloquial equivalent
Very Common	1/1 to 1/10	Person in family
Common	1/10 to 1/100	Person in street
Uncommon	1/100 to 1/1000	Person in village
Rare	1/1000 to 1/10 000	Person in small town
Very rare	Less than 1/10 000	Person in large town

Table 1

The comparative complication rates for vaginal, laparoscopic and abdominal hysterectomy are summarised in [Table 3](#).

Training in laparoscopic surgery

Postgraduate curriculum

Postgraduate gynaecological surgical training in the UK is part of the structured run-through training in obstetrics and gynaecology. Medical graduates undergo Foundation Training over 2 years which provides generic basic training in four-monthly clinical attachment blocks across several different medical specialities, in line with the requirements of the UK General Medical Council. After this period, trainees undertake Specialist Training (ST) in obstetrics and gynaecology over a period of 7 (ST1-7) years pending satisfactory annual reviews.

Specialised training is structured with the first 2 years focusing on basic training in which trainees are expected to achieve the competencies to manage common obstetric and gynaecological emergencies independently (ST1-2) and also to pass the Part1 of the Member of the Royal College of Obstetricians and Gynaecologists (MRCOG) examination.

Risks of Laparoscopic sterilisation and Laparoscopic management of tubal ectopic pregnancy

Risks common to both procedures:

Visceral injury
 Failure to gain entry to abdomen and completion of intended procedure
 Venous thromboembolism
 Death
 Bruising/shoulder pain/wound infection
 Hernia
 Laparotomy + repair of injury
 Blood transfusion

Procedure related risks:

Sterilisation

Failure resulting in unplanned pregnancy (2–5 in 1000) and increased rate of ectopic pregnancy
 Regret, particularly if undertaken under the age of 30 or woman childless.

Ectopic pregnancy

Persistent trophoblastic disease 4% (if salpingotomy)
 Salpingectomy
 Oophorectomy

Table 2

Complication rates of laparoscopic, vaginal and open hysterectomy

	Laparoscopic (%)	Vaginal (%)	Open (%)
Urinary tract injury	1.1	0.2	0.7
Bowel injury	0.4	0.5	0.04
Blood transfusion	0.97	2	2.3
Venous thromboembolism	0.3	1	0.4
Death	0.003	0.03	0.03

Table 3

The next 3 years of the structured training (ST3-5) is then devoted to immediate training whereby the trainee is expected to be trained to the competencies of a generalist and is exposed to training across all the different subspecialist interests of the speciality. The trainee is also expected to have passed the Part 2 and 3 of the MRCOG examination by the end of this training period.

The training in the last 2 years (ST6-7) is concentrated on advanced training and trainees will choose a minimum of two Advanced Training Skills Modules (ATSMs) in order to have a more bespoke training in their chosen subspecialist area for their consultant career. The ATSMs available that are related to gynaecological surgical training are Benign Abdominal Surgery: Open and Laparoscopic, Benign Gynaecological Surgery: Hysteroscopy, Advanced Laparoscopic Surgery for the Excision of Benign Disease and Oncology.

As part of the requirement for the above ATSMs, trainees are also required to attend formal postgraduate minimally access gynaecological surgical training courses in laparoscopy and hysteroscopy.

Teaching approach

To minimise the risks discussed above, structured training is necessary to ensure that the surgery performed safely and complications are minimised and managed adequately. Simulation training is a recommended form of teaching to attain the desired skills in laparoscopic surgery. It allows the clinician to work remotely from the patient to achieve the required competencies and efficiency.

There is a wide range of courses available in gynaecological surgery ([Table 4](#)). In general, emphasis during gynaecology courses is placed on teaching by a hands-on laboratory approach rather than didactic lectures or observing live surgery. Each course is divided into several different sections (see below for

Gynaecological courses available at the Dundee surgical skills centre

Essential and Intermediate Laparoscopic Surgery Skills for Gynaecological Trainees
 Hysteroscopy, Hysteroscopic surgery and endometrial ablation course
 Intermediate Skills in Laparoscopic Suturing Skills for Gynaecological Trainees
 Thiel Cadaveric Laparoscopic Hysterectomy Course
 Thiel Cadaveric Laparoscopic Pelvic Floor Surgery Course

Table 4

examples of gynaecology courses) and each section commences with a short talk (usually about 15 min) with some brief video clips to introduce the subject matter and the aims of the practical exercise and then participants are then encouraged to spend as much time as possible with the exercise.

For the most basic course, the sections will be based on the essentials of surgery, including familiarisation with the laparoscopic and hysteroscopic stack, physics and pitfalls of diathermy and ultrasonic dissection and also basic principles of dissection (sharp, blunt and electrosurgical), haemostasis (with clips and electrosurgery) as well as tissue retrieval techniques. In addition to this, teaching on the various laparoscopic suturing techniques (intracorporeal knot tying with an interrupted reef and surgeons knot, sliding tumble square knot as well as extracorporeal knot tying) is also provided. This is followed by the application of these skills and techniques to actual surgical procedures in routine gynaecology practice such as laparoscopic adhesiolysis, salpingotomy and salpingectomy, oophorectomy and ovarian cystectomy.

Example of teaching materials and models used for training

Due to the constraint of space, the following four examples of the teaching materials and models employed in laparoscopic surgery courses are highlighted.

Ergonomics in laparoscopic surgery

The optimum optical to target view with a 0° laparoscope is 90° (Figure 1). In order to maintain this angle, the laparoscope will need to be held perpendicularly to the umbilicus when it is inserted through an optic port at this site. The field of view obtained with the laparoscope held in this manner would be outside the pelvis and altering this angle in order to view the pelvis would result in distortion to the image seen on the monitor. As shown in Figure 2, the greater the alteration to this optimum optical to target view, the higher the likelihood of surgical errors occurring. The alternative is to use an angled laparoscope such as a 30° scope which will optimise the optical to target view in the pelvis in this situation.

Furthermore, delegates are also taught of the optimum angle between optical axis and laparoscopic instrument (Azimuth angle), between the two laparoscopic instruments in a triangulation set up (manipulation angle) and the angle between the laparoscopic instrument and the target tissue for surgical dissection (elevation angle) (Figure 3).

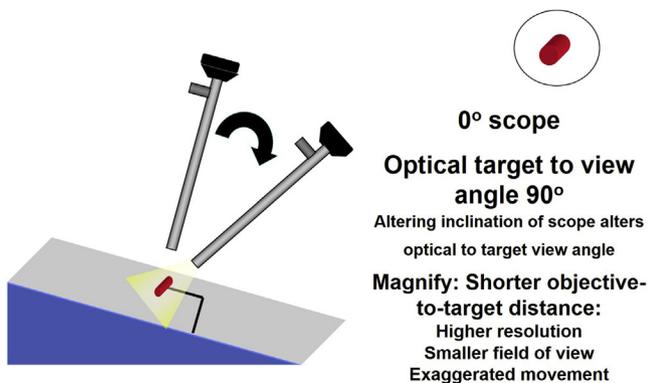


Figure 1 Optical axis-to-target view angle of a 0° laparoscope.

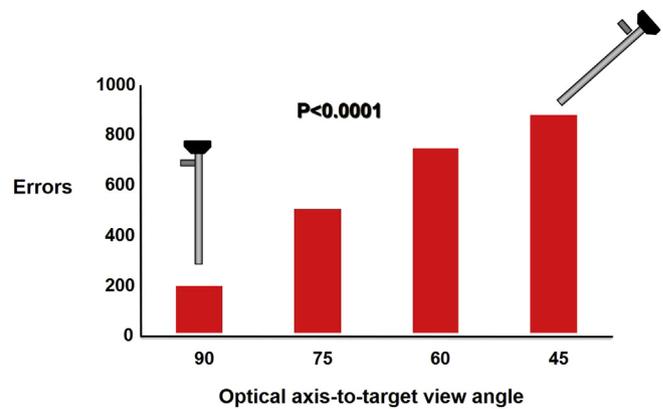


Figure 2 Relationship between surgical errors and altering the optimum optical axis-to-target view angle of 0° laparoscope.

Such knowledge on ergonomics in laparoscopic surgery is employed to minimise operative fatigue in the surgeon and hence subsequently to reduce the amount of operative errors, especially when the surgery involves a significantly long operative time.

Electrosurgery in laparoscopic surgery

Electrosurgery has revolutionised surgical practice. However, it is potentially hazardous and causes more patient injury than any other electromedical device used in the operating theatre.

Electrosurgical generators deliver a frequency of 200 kHz to 3 MHz. As neuromuscular stimulation ceases at a frequency of 100 kHz, current with frequency above this level can be delivered safely and removes the risk of electrocution.

The electrosurgical monopolar circuit consists of four primary parts: the electrosurgical generator, the active electrode, the patient, the return electrode. The active electrode is in the surgical site and the patient return electrode is on the patient's body. When choosing a suitable position for the patient return electrode, consider the position of the patient and planned incision sites. A well vascularised mass should be the area of choice and bony prominences should be avoided.

In bipolar diathermy, the active output and patient return functions are both accomplished at the site of surgery. The current path is confined to the tissue grasped between the tips of the forceps and so a patient return electrode is not necessary for surgery only using bipolar technology.

There are three different diathermy modes: cut, blend and coagulation. These indicate the different waveforms produced by the generator. The current in a cut waveform is constantly employed and generates heat very quickly, allowing the tissue to be vaporised or cut. The current in the coagulation waveform is only switched on intermittently and hence produces less heat. Instead of vaporising tissue, it forms a coagulum. The blend waveform is a modification of the cycle between cut and coagulation, and has three different cycles in some generators. The first blend setting generates heat more quickly than the third and therefore is better at cutting tissues.

When electrosurgery is used in minimally access surgery, it raises a few safety concerns: direct coupling, insulation failure and capacitive coupling. These can all cause significant injury to the patient by creating a new alternate route for the current to flow. Direct coupling occurs with the active electrode is activated

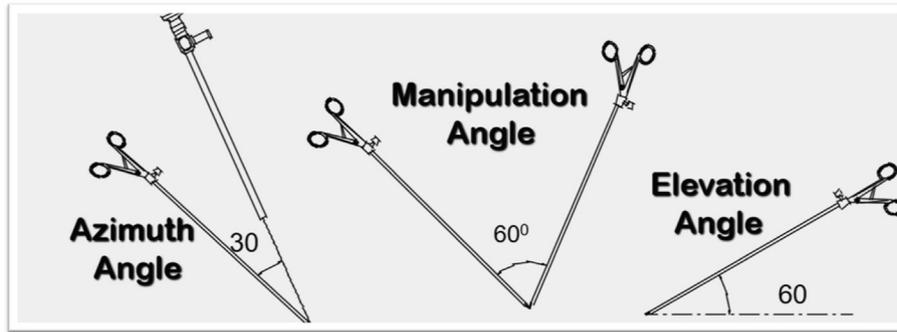


Figure 3 Placement of laparoscopic ports for optimum ergonomics for laparoscopic surgery.

when it is in close proximity with another metal object. The energy will create a new pathway back to the return electrode. Insulation failure occurs when the insulation in the instrument is compromised. The coagulation setting uses a high voltage current and can push the energy through the compromised insulation, which will create a new pathway. A capacitor occurs when 2 conductors are separated by a non-conductor. The most extreme example of this is in a hybrid laparoscopic port system which mixes metal and plastic. This system transmits capacitively coupled energy to the metal cannula, which exits to the surrounding tissue on its way to the return electrode.

In order to prevent complications in electrosurgery, there are a few considerations: careful inspection of the insulation, use of the lowest possible power setting, use cut if the tissues are being divided, use brief activation periods of the current and do not activate the device when in close proximity to another instrument.

Animal tissue model used in laparoscopic salpingotomy/salpingectomy

Laparoscopic salpingotomy and salpingectomy are procedures undertaken for an ectopic pregnancy. The majority of patients with an ectopic pregnancy confirmed on laparoscopy will undergo a laparoscopic salpingectomy rather than a salpingotomy. Given the relatively common incidence for this condition and the risk of maternal death if the condition is not recognised and managed appropriately, the ability to be able to perform a laparoscopic salpingectomy is a core competency for specialist training in obstetrics and gynaecology.

The training model employed to attain this surgical skill is both a synthetic (Figure 4) and an animal tissue model (Figure 5). An example of synthetic model used has foam strips attached to a central disc to allow trainees to be able to either apply preformed endoloops prior to excising them and then retrieving them from the trainer box by using a retrieval bag. The animal model consists of segments of pig small intestine as the fallopian tube mounted on a plastic mount to simulate the uterus and the rest of the pelvis in a box trainer. The ectopic pregnancy tissue is then simulated using dyed pig splenic tissue. This model will allow delegates to either apply monopolar electrosurgery through a straight needle or hook electrode in order to perform a salpingotomy and then to flush out the simulated ectopic pregnancy tissue with a laparoscopic irrigator. For a salpingectomy exercise, the delegates can also apply bipolar diathermy to mesentery of the simulated fallopian tube prior to excising it with

a pair of laparoscopic scissors and then retrieving it in the same manner as that for the synthetic model (see Figure 6).

This model has been evaluated to be realistic and to provide high delegate satisfaction.

Thiel preserved human cadavers for laparoscopic hysterectomy course

In the UK, the use of live perfused animals for surgical training is not permitted. Furthermore, there is also wide variation in the anatomy of the pelvis between human and other animal species like the pig.

The availability of human cadavers for surgical training has allowed teaching to be conducted for the more advanced procedures. Traditionally, cadavers have been embalmed with formalin

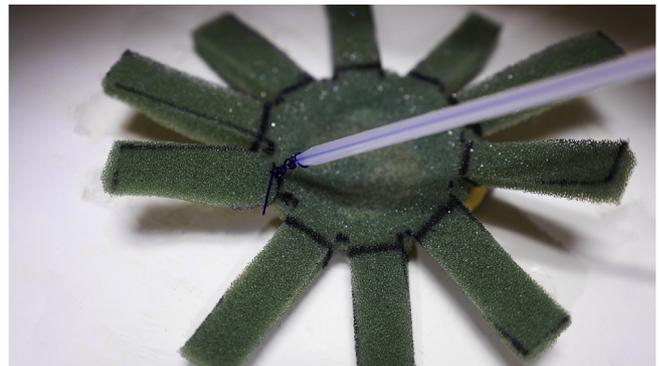


Figure 4 Synthetic salpingectomy model.

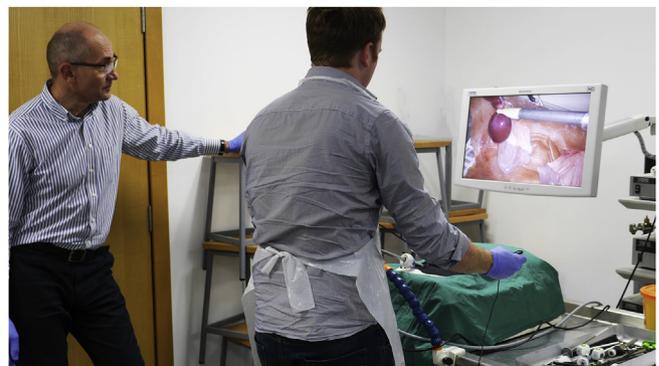


Figure 5 Animal model for laparoscopic salpingotomy/salpingectomy.

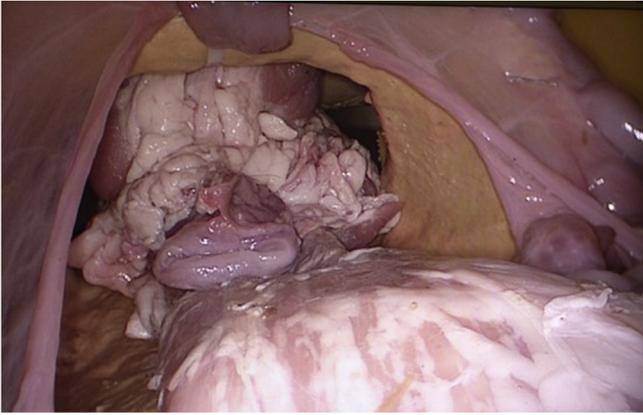


Figure 6 Animal model for laparoscopic suturing for vaginal vault.

but such embalming method results in the discolouration of tissues and tissue which is stiff and inflexible with a leathery consistency. Such cadavers are not suitable for laparoscopic surgical training due to the difficulty in insufflating the abdominal cavity with CO₂ gas. The Centre of Anatomy and Human Identification (CAHID) at the University of Dundee has pioneered an alternative method of human embalming using a non-formalin based embalming (Thiel) technique in order to preserve the tissue colour, flexibility and tissue planes of human organs to allow laparoscopic surgical training.

The alternative to using Thiel embalming to preserve human cadavers for surgical training is to use fresh frozen cadavers. The advantage of using Thiel cadavers is the more guaranteed availability of cadavers for training courses and also the lack of any decomposition odour when compared to fresh frozen cadavers. Another advantage of the Thiel cadaveric model is the same cadaver can be employed for more than one course on different occasions involving surgical dissection to different organs.

In the UK, such cadavers can be used over a maximum period of 3 years for either research and/or surgical training before they have been to be appropriately incinerated.

Clinical governance

Consent

The 2015 Montgomery ruling has practical implications on how clinicians obtain consent and counsel and support patients to make decisions regarding their healthcare. This ruling has updated the law to reflect changes to our clinical practice and encourage a patient-centred approach to health care decisions. Doctors have a legal obligation to ensure that patients are aware of any material risks involved in a proposed treatment, and of any reasonable alternative treatments.

Materiality is defined as 'whether, in the circumstances of the particular case, a reasonable person in the patient's position would be likely to attach significance to the risk, or the doctor is or should reasonably be aware that the particular patient would be likely to attach significance to it'.

Obtaining valid consent is a process of shared decision-making between doctor and patient. This process should not be based on assumptions of what the doctor thinks the patient wants or needs to know. Patients should be informed of the

benefits and risks of all valid treatment options, alternative treatments and the validity of doing nothing at all.

The key points from this discussion should be recorded in the patient's medical notes and a consent form should be filled in and signed. The Royal College of Obstetricians and Gynaecologists have produced consent advice for most of the gynaecological procedures performed.

Audit

Clinical audit is a quality improvement process that measures performance against agreed standards. This allows us to share learning and ultimately maintain patient safety. There are many national audits available for surgical specialties, which support surgeons in reporting their clinical outcomes, which stimulates improvement in safety and effectiveness and allows clinicians to learn from adverse events. For trainees in Obstetrics and Gynaecology, completing an audit project is a mandatory requirement at the Annual Review of Competence Progression (ARCP). Trainees should be supported in completing audit cycles and presenting their findings at their local clinical audit meeting.

Summary

Acquiring the skills to become a laparoscopic surgeon requires many hours of surgical training as there is a learning curve to master. In the current training climate, it is not always easy or possible to achieve the level of experience and practice required. Supervised, structured training and attendance at appropriate courses are essential. Adequate consent should be obtained prior to performing a surgical procedure and a patient-centred approach should be adopted. This encourages transparency and allows the patient to make an informed choice with regards to their treatment.

Clinical governance standards should be adhered to when performing surgical procedures. Complications should be reflected upon to share learning and ensure patient safety. ◆

Practice points

- Laparoscopic surgery confers many advantages over open surgery.
- Performing laparoscopic surgery requires a high level of skill and a structured training programme is required.
- Attending good quality courses will enhance skills and allow practice of laparoscopic techniques prior to attempting these on patients.
- A thorough knowledge of the risks and benefits are required to adequately counsel a patient pre-operatively.
- An appreciation of ergonomics is important to minimise risk to the surgeon.
- In depth knowledge of electrosurgery is vital to ensure safe use of energy devices and minimise risk to patient.
- Regular audit should be undertaken to document local unit surgical performance and to reflect on complications and share learning.

FURTHER READING

- The Royal College of Obstetricians and Gynaecologists. Trainees' guide to the O&G curriculum and specialty training.
- San Lazaro Campillo IS, Meaney S, O'Donoghue K, Corcoran. Ectopic pregnancy hospitalisations: a national population-based study of rates, management and outcomes. *Eur J Obstet Gynecol Reprod Biol* 2018; **231**: 174–9.
- Cheung E, Goodyear G, Yoong W. Medicolegal update on consent: 'the Montgomery ruling'. *The Obstetrician and Gynaecologist* July 2016; **18**(3).
- The Royal College of Obstetricians and Gynaecologists. Consent advice.
- Garry R, Fountain J, Mason S, et al. The eVALuate study: two parallel randomised trials, one comparing laparoscopic with abdominal hysterectomy, the other comparing laparoscopic with vaginal hysterectomy. *BMJ* 2004; **328**: 129.
- Aarts J, Nieboer T, Johnston N, et al. Surgical approach to hysterectomy for benign gynaecological diseases. *Cochrane Database Syst Rev* 2015; **8**.
- National Institute for Health and Care Excellence (NICE). Laparoscopic techniques for hysterectomy, Nov 2007.