Advances in
Equine Laparoscopy
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• Video clips demonstrating selected techniques
Advances in Equine Laparoscopy

Edited by

Claude A. Ragle
Dedication

This book is dedicated to my colleagues in laparoscopy who shared so generously to enrich our knowledge to care for the horse.
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Contributors

Josef Boening, DVM, DECVS
Tierarztliche Klinik, Telgte, Germany

Palle Brink, DVM, DECVS
Jägersro Equine ATG Clinic, Jagersro, Malmo, Sweden

John P. Caron, DVM, MS, DACVS
College of Veterinary Medicine, Michigan State University, East Lansing, MI

Christopher J. Chamness
Karl Storz Endoscopy, Director of Global Business Development-Veterinary, Santa Barbara, CA

Kayla Cochran, DVM
College of Veterinary Medicine, Colorado State University, Fort Collins, CO

Ted Fischer, DVM, DACVS
Chino Valley Equine Hospital, Chino Hills, CA

Boel A. Fransson, DVM, PhD, DACVS
College of Veterinary Medicine, Washington State University, Pullman, WA

Tamara Grubb, DVM, MS, DACVA
College of Veterinary Medicine, Washington State University, Pullman, WA

Dean A. Hendrickson, DVM, MS, DACVS
College of Veterinary Medicine, Colorado State University, Fort Collins, CO

John C. Huhn, DVM, MS
Veterinary Medical Director, Covidien Animal Health, Salem, CT

Andreas Klohnen, DVM, DACVS
Chino Valley Equine Hospital, Chino Hills, CA

Monika Lee, BS
College of Veterinary Medicine, Colorado State University, Fort Collins, CO

Céline Mespoilhes-Rivièere, DVM, DECVS
Ecole Nationale Vétérinaire d’Alfort, Maisons-Alfort Cedex, France

Scott E. Palmer, VMD, DABVP
New Jersey Equine Clinic, Millstone Twp, NJ

John Peroni, DVM, MS, DACVS
College of Veterinary Medicine, University of Georgia, Athens, GA

Claude A. Ragle, DVM, DACVS, DABVP-EP
College of Veterinary Medicine, Washington State University, Pullman, WA
Michael Roecken, DVM, Priv.-Doz.
Veterinary Clinic Starnberg, Starnberg, Germany;
Department of Equine Surgery, School of
Veterinary Medicine, Justus-Liebig-University,
Giessen, Germany

Dwayne H. Rodgeron, DVM, MS, DACVS
Hagyard Equine Medical Institute, Lexington,
KY

Fabrice Rossignol, DVM, DECVS
Clinique de Grosbois, Boissy Saint Leger, France

Jim Schumacher, DVM, MS, MVB, DACVS
College of Veterinary Medicine, University of
Tennessee, Knoxville, TN

John Schumacher, DVM, MS, DACVIM, ABVP
College of Veterinary Medicine, Auburn
University, Auburn, AL

Ceri Sherlock, DVM, DACVS
College of Veterinary Medicine, University of
Georgia, Athens, GA; School of Veterinary
Medicine and Science, Sutton Bonington
Campus, University of Nottingham, Sutton
Bonington, Leicestershire, LE12 5RD, England

Donna L. Shettko, DVM, DACVS
College of Veterinary Medicine, Western
University of Health Sciences, Pomona, CA

Hans Wilderjans, DVM, DECVS
Dierenkliniek De Bosdreef, Moerbeke-Waas,
B-9180, Belgium

David G. Wilson, DVM, DACVS
Western College of Veterinary Medicine,
University of Saskatchewan, Saskatchewan,
Canada
Advances in Equine Laparoscopy is a textbook that will be welcomed by all equine laparoscopic surgeons. Since the 1980s, when merely examining the equine abdomen endoscopically was an exciting revelation, some techniques such as laparoscopic ovariectomy and cryptorchidectomy have developed and matured to become the treatment of choice for most surgeons. By 2012, however, a wide range of laparoscopic procedures have been reported and a publication conflating all this information is most appropriate.

In the human field, despite several reports of endoscopic procedures in the nineteenth century, the received birthplace of laparoscopy was in Dresden in 1901 when George Kelling examined a dog’s abdomen using a Nitze cystoscope; this was followed by endoscopic examinations of the human abdomen. As early as 1927, the first human laparoscopic textbook, *Lehrbuch und Atlas der Laparo- und Thorakoskopie* by Korbsch, was printed. Another significant early contributor was Heinz Kalk, who developed new lens systems in 1929 and published widely on liver and gall bladder disease. Progress predicated not only on the ambition of surgeons but also on technological developments. It was not until the late 1960s that the real expansion of laparoscopy began when Steptoe’s *Laparoscopy for Gynaecology*, describing laparoscopic sterilization techniques, instrumentation, and the use of electrocoagulation, was published.

In the 1970s, over 250,000 laparoscopic sterilizations were performed annually in the United States, but there was little formal training and complication rates were high. As a result, the American Association of Gynecologic Laparoscopists was founded to inform surgeons and to monitor complications, and at about the same time, Chamberlain and Brown (1978) in Britain analyzed prospectively the complication rate in 50,000 laparoscopies. Gradually, an evaluation of what was going wrong and the introduction of credentialing programs has led to a reduction in morbidity and mortality in human laparoscopy.

There are other influences on the use of new techniques: One is the kudos of being able to perform them and another is public pressure for them to be performed, neither driven by the most important indication, viz, the outcomes of the procedures. In human surgery, Cameron and Gadacz (1991) considered these influences a factor in the high incidence of bile duct injuries in laparoscopic cholecystectomies, which were 10 times that of open surgery. Nowadays, medical laparoscopy is under constant review and boasts many laparoscopic procedures that have proven benefits over open surgery.

Laparoscopy has been a stimulating and challenging addition to the veterinary surgeon’s repertoire and as a veterinary discipline it is scarcely 25 years old. As with other fields of surgery, the
development of veterinary laparoscopy has followed that of human laparoscopy but has progressed more slowly. The size of the horse’s abdomen and the weight of some abdominal organs have restricted the range of possible procedures. Like human surgeons in the early days, those of us performing equine laparoscopies in the late 1980s had little guidance and progress was slow, even though our arthroscopic hand–eye skills possibly gave us a better start than our human colleagues who at first only had training in general surgery. There are few studies analyzing morbidity and mortality associated with equine laparoscopy. Anecdotally, high complication rates do not seem to have been the problem they were in human surgery: Perhaps they just have not been reported or maybe we have learned from the human experience. Either way, analysis of complication rates is called for, but at least formal laparoscopic tuition is now available and has become part of the residents’ training program so we can hope that many of the pitfalls will be avoided.

No doubt we also have been driven to perform laparoscopies for the benefit of our image as state-of-the-art surgeons, a fatal trap if our technique is insecure or if there are no benefits to the horse over open surgery. Client pressure can be difficult to ignore or assuage and can also lead us into performing procedures beyond our capabilities. For the benefit of our patients and ultimately their owners, we have a responsibility to evaluate our outcomes; comparative studies that will prove or disprove the benefits of procedures being performed laparoscopically are sorely needed. Once we have this information, we are in a stronger position to advise owners on the best course of action and we are unlikely to perform a laparoscopy because it is fun to do but has no benefit.

A great contribution to the discipline was made when in 2002 Ted Fischer’s landmark textbook, *Equine Diagnostic and Surgical Laparoscopy*, was published giving equine laparoscopists confidence to increase their repertoire and to consolidate their experience. This new text, *Advances in Equine Laparoscopy*, is the fruition of these experiences. Despite its title, the basics are not forgotten. The critical appraisal of training methods is a reminder that certain skills are difficult to acquire and there are many ways to learn them. Laparoscopic skills are some of the most difficult to master in the field of surgery, and a basic competence in instrument and tissue handling in a 3-D cavity with 2-D vision is absolutely essential. Laparoscopic knots cannot be learnt during surgery nor can intracorporeal suturing and knot tying, two famously difficult techniques to master. However since they may be needed in a crisis, especially when hemorrhage is involved, they must be part of the surgeon’s armory before he or she embarks on laparoscopy in the clinical patient. This book offers the opportunity for the inexperienced to discover what there is to learn and how to go about it, and for the experienced it is a reminder to maintain their skills. The thorough coverage of most procedures in common use today provides a basis and, one would hope, a stimulus for comparative studies between open surgery and laparoscopy. It is a reflection of the acceptance of equine laparoscopy that the evaluation of open techniques may have to be retrospective for some procedures. However, an objective appraisal is called for and where enough studies are published even a meta-analysis would be useful.

The time is opportune for a text that not only consolidates our knowledge of the bread-and-butter laparoscopic procedures, such as ovarietomy and cryptorchidectomy, but also offers detailed accounts of those that are proving their efficacy such as closure of the nephrosplenic space and herniorrhaphy. More advanced procedures including nephrectomy, splenectomy, cystotomy, and ovariohysterectomy are also covered. Written by surgeons with good experience of the techniques, this book will facilitate a widening of the laparoscopic repertoire and encourage experienced surgeons to master advanced techniques. Laparoscopy is an unforgiving activity that depends on good technique, and a study of this book will enable surgeons to avoid the mistakes of their predecessors, progress more safely, and benefit the horse and its owner. The skill, knowledge, and judgment of the surgeon are the factors on which the success of surgical procedures depends. *Advances in Equine Laparoscopy* will enhance the quality of all three and will make a significant contribution to the development of this discipline.
References


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John P. Walmsley, MA, VetMB, CertEO, DipECVS, HonFRCVS
The Liphook Equine Hospital
Forest Mere
Liphook
Hants GU30 7JG
UK
The American College of Veterinary Surgeons (ACVS) Foundation is excited to present *Advances in Equine Laparoscopy* as the second book in the book series *Advances in Veterinary Surgery*. The ACVS Foundation is an independently chartered philanthropic organization devoted to advancing the charitable, educational, and scientific goals of the ACVS. Founded in 1965, the ACVS sets the standards for the specialty of veterinary surgery. The ACVS, which is approved by the American Veterinary Medical Association, administers the board certification process for diplomates in veterinary surgery and advances veterinary surgery and education. One of the principal goals of the ACVS Foundation is to foster the advancement of the art and science of veterinary surgery. The Foundation achieves these goals by supporting investigations in the diagnosis and treatment of surgical diseases; increasing educational opportunities for surgeons, surgical residents, and veterinary practitioners; improving surgical training of residents and veterinary students; and bettering animal patients’ care, treatment, and welfare. This collaboration with Wiley-Blackwell benefits all who are interested in veterinary surgery by presenting the latest evidence-based information on a particular surgical topic.

This edition is an outstanding example of the promise of this series. *Advances in Equine Laparoscopy* is edited by Dr. Claude A. Ragle, a diplomate of the ACVS and a prominent equine surgeon. He has assembled the leaders in the field of equine laparoscopy presenting the important techniques and applications for this minimally invasive procedure. As you read through this book, you will find the latest information on the foundations and fundamental skills required for laparoscopy, equipment, techniques for sedation and analgesia required for the use of laparoscopy in horses, and the techniques and applications for a wide range of laparoscopic and thoracoscopic procedures. The ACVS Foundation is proud to partner with Wiley-Blackwell on this important series and is proud to present this second book in the series *Advances in Veterinary Surgery*.

Mark D. Markel  
Chair of the Board of Trustees  
ACVS Foundation
Advances in Equine Laparoscopy (AEL) represents an important update in the practice of minimally invasive surgery (MIS) of the horse. It has been more than three decades since the publication of Animal Laparoscopy, the first veterinary laparoscopy book in which Dr. Witherspoon and colleagues described the basic technique and instrumentation for the laparoscopy of the horse. Ten years separate this publication of AEL from Equine Diagnostic and Surgical Laparoscopy, the first book dedicated to the topic of laparoscopy of the horse. AEL builds upon the stellar contributions of these preceding books. It represents a collaborative gathering of current advances in techniques and instrumentation and is designed to augment and contrast existing texts. The book is organized such that the first several chapters review the fundamental foundations of equine laparoscopy. The following chapters are clinical techniques and are divided into groups based on standing or recumbent positioning of the horse and then on the body system being operated where applicable. A chapter reviewing sedation, analgesia, and/or anesthesia of the horse for laparoscopy precedes each of the two groups of chapters that are based upon the horse’s position during the operation. Each operative technique chapter follows a general framework to provide continuity and to ease locating of information by the reader. This scheme of organization inherently leads to some overlap between related techniques but importantly provides the reader a broader perspective in how clinical experts may approach similar operative challenges in another way. With few exceptions, every technique presented is a procedure that is a current standard of practice in laparoscopy. Not included in this edition of AEL are areas of MIS that are still in their infancy in equine surgery, such as Single Incision Laparoscopic Surgery (SILS), Natural Orifice Translumenal Endoscopic Surgery (NOTES) and Laparoscopic Robotic Surgery; it is anticipated that progress in these techniques in the horse may warrant inclusion in a future edition. This book will be of great interest to all that are interested in the field of MIS and provides an excellent platform for the future advancement of equine laparoscopy.
Acknowledgment

It is with great appreciation I recognize the ACVS Foundation’s Board of Trustees and Dr. Mark Markel (Chair) for creating the *Advances in Veterinary Surgery* series of books and for recognizing the significant progress of laparoscopy in equine surgery. This book would not have been possible without the expert guidance of Erica Judisch and Susan Engelken of Wiley-Blackwell. I also acknowledge Rachael Lencioni, veterinary student extraordinaire, for her tireless efforts and organizational skills working on this book, and Dr. William Dernell, my department chair, for his encouragement. Finally, I would like to acknowledge my extended family and friends, particularly, Boel and my two wonderful daughters, Selma and Ella, for their unconditional love.
Section I

Laparoscopic Skills and Instrumentation
Origins of laparoscopy

Since antiquity, health-care providers have striven to visually examine the internal anatomy of their patients. Indeed, rectal specula and natural light were in use in the era of Hippocrates of Cos (Rosin 1993). Ambient light or external light sources supplemented with diverse lenses or mirrors to examine the ears, nose, mouth, rectum, and vagina/uterus were used until the mid-nineteenth century. Among the first using artificial light was the lichtleiter or “light transmitter” invented by the German physician Philip Bozzini in 1804. The light source for the device was a wax candle, and its glow was reflected by a mirror into a speculum that Bozzini used for the examination of a variety of body orifices and the uterus (Figure 1.1). Unfortunately, as a result of contemptuous reviews of his invention by his contemporaries, the innovation went largely unrecognized by the medical community (Rathert et al. 1974). Perhaps inspired by the work of Bozzini, in 1853, Antonin Desormeaux developed an “endoscope” with a lamp fueled by a mixture of turpentine and alcohol (Kaiser & Corman 2001). The light from the flame was concentrated and directed by a concave mirror to the area of interest and permitted evaluation of the cervix, uterus, and urinary bladder, although it lacked sufficient light for gastroscopy (Figure 1.2) (Rosin 1993; Lau et al. 1997). Unlike the reproach Bozzini’s efforts engendered, Desormeaux received an award from the Royal Academy of Medicine in Paris and went on to use his endoscope for diagnostic and therapeutic procedures in his practice at the Necker Hospital in Paris during the 1860s (Kaiser & Corman 2001).

The first endoscope with an internal light source was the invention of a German dentist, Julius Bruck, in 1867 (Figure 1.3) (Rosin 1993). The light source was an electrically heated platinum wire, which provided improved illumination but generated considerable heat. The potential for tissue burns induced by the instrument was reduced with the addition of a circulating water jacket. Maximilian Nitze, a German urologist, and his colleagues are generally credited with the development of the first rigid telescope in 1879, an instrument equipped with a series of lenses and a light source based on the design of Bruck (Figure 1.4) (Nitze 1879). Following the invention of the

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incandescent bulb by Thomas A. Edison in 1880, it was incorporated into a telescope developed by the Glaswegian David Newman in 1883 (Dame-word 1992). Further developments in lenses and miniaturization of incandescent light bulbs fostered additional advances so that endoscopy of the upper airway, lower urogenital tract, esophagus, stomach, and anorectum began to be conducted with some frequency. Although the thoracic and peritoneal cavities were yet to be examined, the equipment and methodology to do so was largely in place (Lau et al. 1997).

In 1901, the abdominal cavity of a pregnant woman was examined by Dimitri von Ott, who employed a speculum introduced into the abdominal cavity via small colpotomy. External light was reflected into the speculum with a head mirror, a technique he called “ventroscoopy” (Von Ott 1901). While his efforts presaged Natural Orifice Translumenal Endoscopic Surgery (NOTES) procedures, it is not regarded as laparoscopy in the conventional sense by many medical historians. Priority for “true” laparoscopic examination of the abdomen is afforded the German surgeon Georg Kelling, who used a Nitze-style cystoscope to examine the peritoneal cavity of dogs in 1901. Kelling created pneumoperitoneum with filtered air and called the technique “koelioskopie” (Figure 1.5) (Kelling 1902; Rosin 1993). Although Kelling later reported the use of laparoscopic methods in a series of human patients, Hans Christian Jacobaeus, a Swedish surgeon, is credited with the first report of a relatively large series of “laparothorakoskopie” procedures in people, published in 1911 (Jacobaeus 1911). Unlike Kelling, Jacobaeus did not use abdominal insufflation; however, many of his patients had ascites, which afforded working space. As is typical in medicine, progress tends to occur in parallel; an American surgeon, Bertram Bernheim, also reported on two laparoscopically managed patients in 1911 (Bernheim 1911). Evidently, enthusiasm for the concept of laparoscopy spread rapidly in the ensuing years; a
in humans and horses from the time of Kelling’s work are illustrated in Figure 1.6.

Subsequent developments

A number of technical improvements in endoscopy were realized in the early twentieth century. Laparoscopic examination of pelvic organs was improved by the adoption of Trendelenburg positioning, the subject of a report by the Danish surgeon Severin Nordentoft in 1912 (Nordentoft 1912). Advances in instrumentation included the invention of a needle to establish pneumoperitoneum (Korbsch 1921), the introduction of insufflators (Goetze 1921), and optical improvements in telescopes (Unverricht 1923). The use of CO₂ as an insufflation gas was introduced by Zollikofer in 1924 (Zollikofer 1924), and the first operative laparoscopy is attributed to the German laparoscopist Carl Fervers, who conducted laparoscopic liver biopsies and lysed abdominal adhesions under direct observation (Gotz et al. 1993).

A number of individuals pioneered further technical and operative innovations in the discipline. Among them was the hepatologist Heinz Kalk, who introduced oblique-viewing telescopes and a variety of hand instruments and devised the use of a second operative (instrument) portal as early as 1929 (Kalk 1929). In the period between 1929 and 1959, Kalk published over 20 papers on laparoscopy, including a monograph on laparoscopic surgery with W. Bruhl in 1951 (Kalk & Bruhl 1951). Many consider Kalk the father of modern laparoscopy (Figure 1.7). In 1938, Janos Veres (frequently incorrectly spelled Veress), a Hungarian physician, improved on existing pneumoperitoneum needles by inventing one equipped with a spring-loaded obturator to reduce injuries to abdominal viscera when establishing pneumoperitoneum.
Advances in Equine Laparoscopy

optically correct field of view. The work of Hopkins and his coworkers formed the basis for flexible fiber-optic endoscopes and modern rigid laparoscopes.

Among the greatest innovators in the development of modern laparoscopy was the German engineer and surgeon Kurt Semm. Indeed, his contributions are largely responsible for the current trend for minimally invasive surgery (Spaner & Warnock 1997). The development of the automatic insufflator, the morcellator, a variety of hand instruments, the ligating loop, and techniques for extracorporeal knot tying and intracorporeal suturing are all attributable to Dr. Semm. Additional contributions include advancing surgical techniques for tumor staging, adhesiolysis, and applications for bipolar electrocautery. He also invented a laparoscopic training device, the “pelvitrainer.” Semm published extensively and a number of his gynecologic procedures appear in a surgical atlas on “pelviscopy” in a number of languages (Semm 1992). With this staggering list of accomplishments, it is not surprising that Semm earned his share of habitual detractors (Litynski 1996a). Indeed, though his principal professional interest was gynecologic surgery, he conducted the first laparoscopic appendectomy in 1980 (Semm 1989), and the presentation of his work was met with such opposition that it was not published until 3 years later (Vilardell 2006).

Rapid growth of human laparoscopy

Despite important developments in electrocautery equipment and other advances, the growth of laparoscopy in general surgery was tentative through the 1960s and 1970s. In September of 1985, Erich Mühe, in a private hospital in Böblingen Germany, conducted the first laparoscopic cholecystectomy using a “galloscope” of his own design (Litynski 1996b; Lau et al. 1997). Mühe’s lack of enthusiasm for publication resulted in limited awareness of this accomplishment, and the first laparoscopic cholecystectomy was often attributed to Phillipe Mouret, a general surgeon from Lyon, France, in 1987 (Nagy et al. 1992; Gotz et al. 1993; Spaner & Warnock 1997). The laparoscopic cholecystectomy was an important advance; it was rapidly adopted by a number of centers in

The eponymous insufflation needle remains in use today (Veress 1938).

A revolutionary development was the introduction of cold light fiberglass illumination, the product of the efforts of French scientist Max Four estier and his colleagues in 1952 (Four estier et al. 1952). This advance both decreased the risks of burns associated with previous methods of illumination and provided sufficient light to enhance the quality of endophotography. The contribution of Four estier and his colleagues, combined with the development of a more robust and optically much improved rod lens system by the English physicist Harold Hopkins, opened new vistas in endoscopy and laparoscopy (Hopkins & Kapany 1954). In addition to virtually eliminating the pervasive risk of burns from previous light sources, there was now the capacity to enjoy a wider and more

Figure 1.5 Georg Kelling, a German surgeon, is generally credited with the first “true” laparoscopy. He published on the use of a Nitze-style cystoscope and filtered air insufflation to examine the abdominal organs of dogs in 1901.