



1 Clinical Opinion

 2 **When Will Minimally Invasive Surgery Replace Almost All**
 3 **Open Surgeries?**

 4
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 7
 8 **ABSTRACT** This article traces the development of laparoscopy, and establishment resistance to its emergence as the technique to replace
 9 almost all laparotomies. Journal of Minimally Invasive Gynecology (2012) ■, ■-■ © 2012 AAGL. All rights reserved.

 10 *Keywords:* Endoscopy; Keyhole surgery; Laparoscopy; Laparotomy; Laser surgery; Minimally invasive surgery; Robotic surgery; Robotic-assisted
 11 laparoscopy; Video-assisted endoscopy; Video-assisted laparoscopy

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 18 Jacobaeus performed the first successful series of opera-
 19 tive laparoscopies in 1910 [1]. The successful introduction
 20 of the scope into an area once thought inaccessible seemed
 21 to captivate the world, and soon the fledgling new field of
 22 laparoscopy was on the ascendancy, shining with impon-
 23 derable promise [2–5]. So enthralled were many during
 24 this heyday in the 1910s to 1930s that soon the literature
 25 was teeming with soaring superlatives, with one early
 26 enthusiast describing laparoscopy as “the fulfillment of
 27 a dream” [6]. Interest in the new field was said to have
 28 been so piqued that by the 1930s, concerns about overen-
 29 thusiasm arose [2]. Articulating such cautionary sentiments
 30 well was C. Abbot Beling [7], a successful laparoscopist-
 31 internist from New Jersey, who noted in 1941 that “Mira-
 32 cles were wrongly hoped for in situations where the use
 33 of the peritoneoscope was not indicated.”

 34 Such optimism was not unwarranted because most imme-
 35 diately realized the new technology had the potential to end
 36 at last the practice of exploratory laparotomy, the procedure
 37 it was designed to replace, bemoaned by endoscopists since

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 39
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 at least 1898, and one that mid-century laparoscopist John
 Ruddock [8] declared “should be condemned.”

 Then all was quiet on the laparoscopic front [2]. Like clock-
 work, it seems, the repeating pattern of institutional inertia
 began anew, bringing innovation to a withering halt, an effect
 plainly evident when one considers that until the early 1980s,
 operative endoscopy had essentially progressed no farther
 than the same procedures introduced earlier in the century:
 draining cysts, lysing adhesions, biopsying, and cautery of
 neoplasms [2]. As for one of gynecology’s most advanced lap-
 aroscopic procedures until the early 1980s, tubal sterilization,
 it got its start decades earlier when Boesch, a Swiss surgeon,
 performed the first laparoscopic tubal sterilization in 1936 [9].

 Indeed, with the exception of contributions from the 20th
 century’s few virtuosos, including Bruhat, Cohen, Frangen-
 heim, Gomel, Manhes, Palmer, Semm, and Steptoe, the en-
 tire discipline of gynecologic operative laparoscopy seemed
 stalled for what seemed like was going to be forever at tubal
 sterilization, as if it were the final frontier.

 Such arrested development was not the exclusive domain
 of gynecology. By the end of the 1970s, laparoscopy in gen-
 eral surgery had essentially advanced no farther than liver
 biopsy, the same procedure that Germany’s Heinz Kalk
 and Carl Fervers had achieved in the 1930s [2,10,11].

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The Price We Pay for Institutional Inertia
 In terms of the toll on human lives, the cost of such delays
 in advancing minimally invasive surgery is not so readily

90 apparent, especially because they occurred in a forgotten
91 past that invariably fades from our memory like a fleeting
92 aberration. Yet, when comparing surgical outcomes of today
93 with those from just 30 years ago, we can see that the price
94 paid was staggering, in particular for those with chronic
95 disorders, which can require multiple surgical interventions
96 to treat. For example, before video-assisted endoscopy, fe-
97 male patients with chronic disorders such as endometriosis
98 often had no choice but to undergo multiple laparotomies
99 to treat sometimes only minimal disease. Research centers
100 such as the World Endometriosis Research Foundation esti-
101 mate that as many as 170 million women worldwide have
102 endometriosis. By this example alone, we can see that the
103 hidden cost of our collective inertia may have adversely
104 affected millions of lives [12]. And so it was that worldwide,
105 in all surgical disciplines, shock-inducing incisions were
106 made in treatment of what sometimes were the mildest of
107 maladies [10].

109 **“Sometimes Good Things Fall Apart So That Better 110 Things Can Fall Together” [Jessica Howell]**

112 Like disruptive technologies are apt to do, the introduction
113 of video-assisted endoscopy called into question nearly 2
114 centuries of cherished traditions, ushering in the inescapable
115 new reality that 170 years of surgical norms were no longer
116 optimal care and that large incisions were not only unneces-
117 sary in most cases, but they often risked causing even more
118 chronic pain and morbidity than the original illness.

119 After witnessing outcomes that seemed nothing short of
120 categorical miracles, even for notoriously difficult surgeries
121 such as bowel, bladder, or ureter resection or reanastomosis;
122 radical hysterectomy; pelvic and para-aortic lymph node
123 dissection; sacral colpopexy; management of ovarian rem-
124 nant syndrome; and laparoscopy in advanced pregnancy, in
125 1990, our team could not help but proclaim that “In 20 years,
126 major abdominal surgery will be nearly extinct.” Carrying
127 on with our unabashed declaratives, we went on to state
128 that with endoscopy “You can see better; and if you see bet-
129 ter, you can do better,” noting too that “Wherever in the
130 body a cavity exists or...can be created, video-assisted
131 endoscopy is indicated and probably preferable. The limit-
132 ing factors are skill and experience of the surgeon and the
133 availability of proper instrumentation” [13–24].

134 What we failed to foresee, however, was just how many
135 epic academic brawls would ensue as a result of this unwel-
136 come threat to the entire order of things [25–30]. In the
137 early 1980s, for example, one reviewer lambasted our first
138 manuscript to bits, declaring in no uncertain terms that
139 “The authors’ [Nezhat et al] recommendation to operate on
140 the monitor instead of looking through the laparoscope is
141 dangerous and irresponsible. It could lead to severe
142 complications and death of...patients. Only 1 out of 200
143 surgeons might be able to operate on the monitor and off
144 the images the way Nezhat recommends” [31]. In the late
145 1980s, another reviewer found our first report on laparoscopic

146 bowel resections so unconscionable that he could barely
147 contain his ire, calling the entire enterprise “barbaric” [31].

148 Even after collecting years of sound clinical data
149 [2,4,32–51], video-assisted endoscopy continued to be the
150 subject of nearly universal derision for most of the 20th
151 century, dismissed as a glitzy gimmick of sorts, an implausi-
152 ble bubble just waiting to burst into oblivion [14,52–59].

154 **The Moment of Reckoning Is Finally Here**

155 It was only after overwhelming evidence in favor of the
156 new surgical philosophy accreted to a point where it became
157 impossible to ignore that open surgery was finally subjected
158 to more rigorous critical analysis, a nearly 30-year process
159 that ultimately has led to its worldwide downfall as the cri-
160 terion standard of surgery [2,13]. More remarkable, even
161 with elderly, pediatric, obese, emergency, and oncologic
162 patients, in whom video-assisted endoscopy had remained
163 staunchly contraindicated for most of the 20th century,
164 a breathtaking reversal has occurred as physicians in these
165 fields are now beseeching their colleagues to phase out over-
166 reliance on large incisions and embrace video-assisted
167 endoscopy as their aspirational criterion standard of choice
168 [2,13,60–63].

170 Even the most advanced laparoscopic procedures, those
171 referred to as imprudent and infeasible for most of the
172 20th century [64], are now considered so superior to laparot-
173 omy that the *New England Journal of Medicine* dedicated an
174 entire editorial on the subject, noting that “Technological
175 advances, which are followed by long periods of catch-up
176 while clinicians learn how to use the new techniques appro-
177 priately, often precede true medical progress. Early on, sur-
178 geons were hampered by having to steady the laparoscope
179 with one hand and look through a small lens while perform-
180 ing surgery with the other hand. Advances in laparoscopic
181 surgery were facilitated by a series of innovations that allow
182 true video surgery, in which two surgeons work together
183 with both hands to perform operations. Surgeons must
184 progress beyond the traditional techniques of cutting and
185 sewing..., to a future in which...minimal access to the
186 abdominal cavity [is] only the beginning” [58]. How ironic
187 that the procedure of laparoscopic colectomy referenced in
188 this editorial, the same one first presented at the World
189 Congress on Fertility and Sterility in 1988, was the very
190 procedure referred to as “barbaric” just a few years earlier
191 [27,29,31,65,66].

193 **Critical Reappraisal**

194 Perhaps of greatest significance, the introduction of min-
195 imally invasive surgery is catalyzing a long-overdue moment
196 of reckoning, when all surgical traditions are finally being
197 held to the light of scrutiny. For example, with the new min-
198 imally invasive philosophy leading the way, emphasis on
199 sparing reproductive organs is becoming the norm in gyne-
200 cology, rather than the exception. Another profound effect
201

202 has been the way video-assisted endoscopy has revolution-
 203 ized our understanding of anatomy. Just through these new
 204 insights alone, most likely all of the anatomy textbooks
 205 that relied on the old techniques of open surgery will need
 206 to be entirely rewritten. And surgical outcomes once consid-
 207 ered unavoidable in the days of open surgery are suddenly
 208 being reevaluated as physicians are finally acknowledging
 209 just how many severe complications such aggressive surger-
 210 ies have been subjecting patients to all along [67–75].
 211

212 Enigmatic Disease States Are Finally Being Understood

213
 214 A greater understanding of disease states has also been
 215 achieved as a direct result of video-assisted endoscopy.
 216 The case of endometriosis is particularly striking. Often
 217 invisible to the naked eye and inscrutable in its etiology,
 218 for most of the 20th century, many patients with endometri-
 219 osis were just as likely to be referred to a psychiatrist as
 220 a gynecologist, with their inexplicable multiple-organ symp-
 221 toms mistaken as psychosomatic disorders [2,53,76–78].
 222 With studies as recently as 1995 reporting that in up to
 223 50% of patients with chronic pelvic pain there was no
 224 apparent organic basis, this meant that nearly half of all
 225 women seeking medical care because of pelvic pain were
 226 susceptible to receiving inadequate care or to enduring
 227 unflattering assumptions about their character [2,53,79].
 228 With the penchant of endometriosis to produce acute
 229 symptoms commonly mistaken for life-threatening condi-
 230 tions such as ectopic pregnancy, kidney disease, malignancy,
 231 and appendicitis, in the days before video-assisted endos-
 232 copy, women with the disorder commonly underwent
 233 multiple laparotomies, which sometimes proved entirely un-
 234 necessary. Although the large incisions of laparotomy
 235 should have helped practitioners to detect its presence, endo-
 236 metriosis continued to evade the clinical gaze. Not until late
 237 in the 20th century was the multitude of morphologic fea-
 238 tures the disorder can take actually become more fully
 239 recognized, a change many attribute to video-assisted endos-
 240 copy, which began displacing laparotomy as the preferred
 241 diagnostic and operative method for endometriosis during
 242 the same time frame [80,81].

243 Like many of my colleagues who are familiar with this
 244 confounding disorder, I had long suspected endometriosis
 245 was the cause behind many cases of chronic pelvic pain,
 246 even when the anatomy appeared normal at first glance.
 247 When I switched to video-assisted endoscopy, what I saw
 248 took my breath away. For the first time in my career, I was
 249 able to consistently visualize atypical lesions that could
 250 have easily been mistaken for normal tissue but that now, un-
 251 der video magnification, could be clearly seen as pathologic
 252 formations. I had never obtained such stunning visualization
 253 while performing diagnostic laparoscopy using the old
 254 method of peering into the eyepiece, or even from the van-
 255 tage point of the supposedly superior views obtained via
 256 large incisions. Now I was able to find an organic cause in
 257 patients more than 90% of the time [82]. By the late

1980s, other converts to video-assisted laparoscopy began
 reporting similar clinical findings, which overturned nearly
 a century of statistics that had misrepresented the true prev-
 alence and proclivities of endometriosis, finally revealing
 what patients had been experiencing all along [83–92].

Where We Stand Today

Although it is encouraging to see that we have finally bro-
 ken free from beliefs that stood unchallenged for centuries, it
 staggers the senses to consider how long it took to achieve
 this change, how many proverbial guns were drawn and bat-
 tles waged, just so we could arrive where we are today, at the
 mere tip of a new era in which still no more than 30% of all
 major surgeries are being performed using minimally inva-
 sive techniques [93].

Why is this? Why do surgeons apparently ignore the pre-
 ponderance of evidence demonstrating the unequivocal ad-
 vantages that minimally invasive surgery can offer?

It seems the most likely answer takes us back to the ines-
 capable issues of tradition, training, and instrumentation, the
 same roadblocks that nearly derailed the transition to trans-
 verse incisions, the same ones we identified decades ago
 [13,24]. Just as it was 30 years ago, video-assisted endos-
 copy continues to be one of the most difficult techniques
 to learn, which means that most surgeons simply have not
 been able to gain the depth of experience necessary to reach
 a level of proficiency comparable to that with laparotomy.
 This is especially true considering that the typical practi-
 tioner performs surgery infrequently, perhaps only several
 times a month. At that rate, it will take years before most
 can attain competency in advanced procedures because
 well over a hundred are needed to be performed before
 even basic proficiency can be achieved. Compounding the
 problem is that only a limited number of surgeons today
 are experienced enough themselves to teach advanced lapa-
 roscopic procedures. Meanwhile, the lack of proper instru-
 mentation has proved to be an especially persistent
 nuisance, standing in the way of progress. No matter how
 great a pianist you are or want to be, you cannot play if
 you do not have a piano or if the one you have is utterly
 out of tune. While somewhat of a peripheral factor, the issue
 of inadequate reimbursement also serves as another potential
 disincentive, an unfortunate trend one author recently char-
 acterized as “a seemingly inexorable decline in reimburse-
 ment for operative procedures” [94].

The ethos of orthodoxy still permeating many medical in-
 stitutes completes this vicious circle, standing ever stalwart
 against the new and unknown, making it difficult at times to
 initiate the changes needed to overcome these outstanding
 obstacles. Just as many resisted the transition to video-
 endoscopy, critics today are now focusing their sights on
 new-generation technologies such as robotics, a field some
 have dismissed as nothing more than an expensive superflu-
 ous flop, a criticism nearly identical to that once made about
 video-assisted endoscopy [95–97]. An article from 2009

314 even asked: "Robot for Coronary Artery Bypass Grafting: A
315 'million dollar coat hanger'?" [98]. With impediments such
316 as these still bogging us down, it is no wonder that the tradi-
317 tional, more readily mastered method of laparotomy has
318 remained the default procedure of choice.

319 As for dilemmas, more confounding ones could scarcely
320 be imagined; yet this is exactly where the opportunities lie.
321 Thirty years ago, when few could see past the seemingly
322 insurmountable shortcomings of video-assisted endoscopy,
323 including its 2-dimensional field, encumbered dexterity,
324 and counterintuitive motions, what most were also unable
325 to imagine was the day when enterprising engineers such
326 as Ajit Shah and Al Greene would develop the Da Vinci
327 robot, overcoming in an instant the obstacles that seemed
328 destined to be the eternal doom of our discipline.

329 From this example alone, we can see that it is only a mat-
330 ter of time before others will tap into those hidden reserves
331 of potential lying just beneath the surface of things, so that
332 even the most urgent situations such as hemorrhage from
333 large-vessel injuries will one day be routinely managed
334 through minimally invasive means. Even now, technologies
335 exist that could enable robots to perform surgeries based on
336 the programmed movements of advanced surgeons as
337 recorded by motion-detection sensors. If we could solve
338 the shortcomings of trocar insertions, which account for ap-
339 proximately 40% of laparoscopic complications and most
340 laparoscopy-associated deaths [99–103], perhaps this
341 could prove to be just the sort of tipping point needed to
342 bring surgeons closer to achieving greater confidence and
343 competency in minimally invasive surgery.

344 Urgent Call to Action

345 As for the estimated 4 million to 7 million [104,105]
346 laparotomies still being performed in the United States
347 every year, it is my belief that this figure should be
348 considered unacceptable, if not appalling, especially
349 considering that we have spent the last 30 years proving
350 that even the most advanced procedures can be safely
351 performed in a minimally invasive manner.

352 If patients could vote, we know they would have elected
353 to end large incisions long ago, considering that they are
354 the ones paying the greatest price for these disappointing delays
355 in progress. Take, for example, the issue of laparotomy-
356 induced adhesions, thought to occur in more than 93% of
357 all patients who undergo the procedure [106–108]. Based
358 on several long-term studies, the more severe forms of these
359 iatrogenic adhesions are estimated to cause intestinal
360 obstructions that require additional open surgery to manage
361 in as many as 15% of cases, statistics that translate to nearly
362 half a million patients potentially affected by this adverse
363 outcome each year [106–111].

364 For millions of patients, then, the clock is definitely still
365 tick, tick, ticking. In view of how much is at stake for
366 patients, I believe it is time to renew our commitment to
367 advancing minimally invasive surgery, to recognize that

370 "the fierce urgency of now" is before us, urging us to take
371 back the reins and begin anew.

372 Alas, we will probably have to wait with exquisite impa-
373 tience to see any real change, inasmuch as history suggests
374 that achieving such transformative milestones in medicine
375 usually takes about a hundred plodding years to occur; and
376 so it seems will be the case for video-assisted endoscopy.
377 If we cannot find a way to break free from these chains of
378 history, then it seems another insufferable 70 years will
379 have to pass before we can reach the other side.

380 Even so, there is no doubt in my mind that the era of large
381 incisions is surely coming to an end, and that almost all lap-
382 arotomies will be replaced by minimally invasive surgery,
383 with only a few exceptions such as cesarean section deliv-
384 eries and organ transplantations, which, in any case, will be
385 performed in part using minimally invasive methods. What-
386 ever the odds, whatever it takes, my ardent wish is that we do
387 not have to wait too much longer to see the day when lapa-
388 rotomies are finally shipped back to the heap pile of history.


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