



Contemporary diagnosis and management of traumatic rectal injuries

Brent Emigh, Kenji Inaba, Morgan Schellenberg*

Division of Trauma and Surgical Critical Care, LAC+USC Medical Center, University of Southern California, 2051 Marengo Street, Inpatient Tower, C5L100, Los Angeles, CA 90033, United States

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ABSTRACT

Rectal injuries are rare but potentially devastating injuries that are frequently associated with penetrating pelvic trauma or blunt pelvic fractures. Management principles for these injuries have gone through major paradigm shifts over time. Recently, large-scale civilian studies have been completed, providing valuable insight on best-practice strategies for contemporary trauma populations. The diagnosis of rectal injuries is accomplished with a combination of computed tomography (CT) scanning and rigid proctoscopy. Because the rectum is comprised of two distinct anatomic segments, the intra- and extraperitoneal rectum, management principles for rectal injuries are unique. Intraperitoneal rectal injuries are managed as colonic injuries, with small injuries primarily repaired and larger injuries resected. Extraperitoneal injuries are repaired primarily via a trans-anal approach, if feasible, and otherwise are managed with proximal diversion alone. Complications seen after rectal injuries include infection, strictures, and fistulae. The most provocative questions about rectal injuries that are currently unanswered relate to the possibility of nonoperative management for penetrating extraperitoneal rectal injuries and to the optimal timing of colostomy reversal after proximal diversion for extraperitoneal injuries.

Introduction

Despite their relative infrequency, traumatic rectal injuries remain a challenge to diagnose and manage. Rectal injuries have been historically treated with a combination of modalities, including primary repair, proximal diversion, presacral drainage, distal rectal washout, or even nonoperative management. Until recently, there has been a paucity of evidence guiding the management of civilian rectal injuries. The purpose of this chapter is to provide a modern review of the management of traumatic rectal injuries, including a summary of the historic context for these injuries, as well as the epidemiology and anatomical considerations relevant to these injuries. The majority of this review will focus on evidence-based diagnosis and management principles for blunt and penetrating intra- and extraperitoneal rectal injuries.

History

As a consequence of the association of rectal trauma with gunshot wounds, major philosophical changes in the management of rectal injuries can be traced back to periods of armed conflict. During the civil war, penetrating colorectal injuries were almost universally managed nonoperatively, with resulting mortality rates approaching 90% [1]. Surgical repair of rectal injuries was first formally described among World War I soldiers [2], although the adoption of proximal diversion and its association with reduced mortality was not described until World War

II [3]. Higher-velocity rectal injuries were then encountered during the Vietnam War, leading to a classic management principle termed the four D's; direct repair, drainage, diversion, and distal rectal washout [4]. Recent military conflicts in the Middle East have continued to add to the collective experience with rectal trauma [5–8].

Despite these advances in the military literature, civilian trauma surgeons should remain cautious in their adoption of war-time surgical principles. Soldiers are generally younger and healthier than their civilian trauma counterparts; transport and evacuation times may be greater in the military setting; and wounding mechanisms differ between military and civilian settings, with a large proportion of rectal injuries in theater related to explosions and blast injuries [5], which are exceedingly rare in the American civilian population. These differences challenge the accurate extrapolation of military data to the civilian setting.

The initial large-scale studies of rectal trauma in the civilian population were published in the 21st century. The first of these was authored by Demetriades et al. in 2001, which demonstrated reduced mortality when rectal injuries were managed with primary repair instead of proximal diversion [9]. In 2018, Brown et al. published the largest civilian multicenter study of rectal injuries to date and demonstrated an increase in morbidity when intraperitoneal rectal injuries were managed with proximal diversion [10]. These studies, amongst a few others, form the foundation of the principles of contemporary management of civilian rectal injuries.

* Corresponding author.

E-mail address: morgan.schellenberg@med.usc.edu (M. Schellenberg).

Anatomical considerations

The rectum is a portion of the large intestine that begins at the rectosigmoid junction, which is identified anatomically by the coalescence of the tenia coli at the distal sigmoid colon. Distally, the rectum transitions into the anal canal, an anatomic distinction that is primarily histologic. The rectum is approximately 12–15 cm long and functions in fecal storage prior to defecation. The blood supply of the rectum changes along its length, with the proximal 2/3rd^s of the rectum supplied by the superior rectal artery and the distal third supplied by the middle and inferior rectal arteries. The anatomic relationship of the rectum to the peritoneal reflection in the pelvis carries critical implications for injury management. Based on the location of the peritoneal reflection, the intraperitoneal rectum is comprised of the proximal two thirds of the anterior rectum and the proximal third of the lateral rectum. The remainder of the rectum is extraperitoneal. The anatomic boundary imparted by the peritoneal reflection allows for confined fecal spillage after extraperitoneal rectal injury without intra-abdominal extension. Conversely, injuries to the intraperitoneal rectal can lead to gross contamination of the peritoneal cavity if not managed promptly.

Rectal injuries are generally graded using the American Association for the Surgery of Trauma (AAST) injury classification [11]. Grade I injuries consist of contusions, hematomas without devascularization, and partial-thickness lacerations. Grade II injuries comprise full-thickness lacerations that span <50% of the rectum circumference, while Grade III injuries are those encompassing ≥50% of the circumference. Grade IV injuries include lacerations that extend to the perineum. Grade V injuries are defined by devascularized rectal segments.

Rectal injuries can also be categorized into non-destructive (<50% of the rectal circumference) or destructive (≥50% circumference, injuries causing malperfusion, or multiple rectal injuries in close proximity) [12]. However, this distinction is largely historic, as contemporary injury management is now dictated primarily by anatomic location of the injury relative to the peritoneal reflection, i.e. intraperitoneal vs. extraperitoneal, as opposed to circumferential extent.

Epidemiology

The overall incidence of rectal injury is low. A 2018 retrospective analysis of the American College of Surgeons (ACS) Committee on Trauma (COT)'s National Trauma Data Bank (NTDB) reported only 1472 rectal injuries in the US over a two-year period, for an overall incidence of 0.1% [13]. Notably, this rate is significantly less than the incidence of reported wartime rectal injuries, which was 1.4% among patients treated during Operation Iraqi Freedom, for example [6]. Despite the difference in incidence between the civilian and military settings, morbidity and mortality after rectal trauma are comparable between these scenarios [5,8]. Penetrating mechanisms of injury predominate in the civilian setting, with studies reporting up to 85% of all rectal injuries to be the result of penetrating trauma [10,13–15].

Diagnosis

The initial management of all trauma patients should follow the standard ACS Advanced Trauma Life Support (ATLS) guidelines. The diagnosis and initial management of rectal injuries form part of the secondary survey and should only be pursued once immediately life-threatening injuries have been excluded or addressed.

A high degree of suspicion is required to avoid the potential disastrous consequences of a missed or delayed diagnosis of rectal injury. The patient history and physical exam will often provide the first indicators that a rectal injury is present. All penetrating injuries in the abdominopelvic region, including the buttocks, groins, proximal thighs, perineum, and sacrum, place the rectum at risk for injury. Penetrating gluteal injuries, for example, have been found to impart a 25% risk of

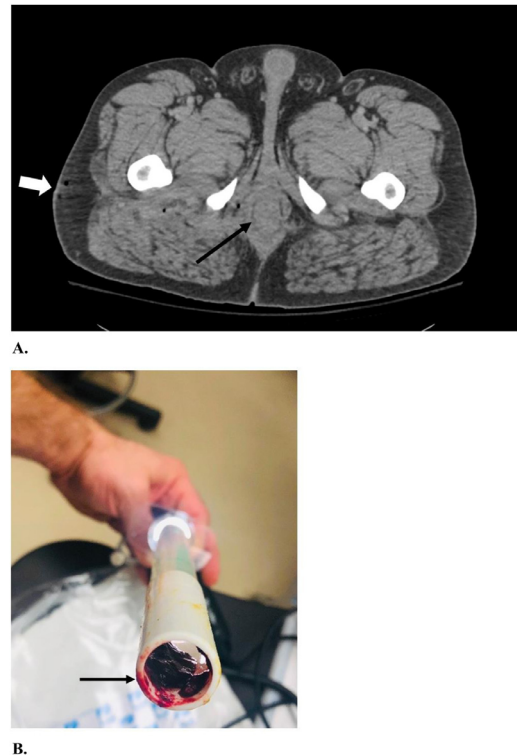


Fig. 1. A-B. Extraperitoneal Rectal Injury Following Gunshot Wound. A, The wound trajectory is seen on computed tomography (CT) scan (white arrow) and suggests injury to the extraperitoneal rectum (black arrow). B, Rigid proctoscopy demonstrates intraluminal blood (arrow) and two luminal defects (not shown) in the extraperitoneal rectum. The patient was treated with proximal diversion via a loop sigmoid colostomy.

rectal injury [7]. Trans-pelvic gunshot wounds are generally considered to have a rectal injury until proven otherwise. After blunt mechanisms, patients with major pelvic or perineal injuries, such as open-book pelvic fractures, are considered high risk for associated rectal injury.

In terms of the initial physical exam and diagnostic work-up for rectal injury, although long-considered to be an essential component of the secondary survey for all trauma patients, the digital rectal exam (DRE) has low sensitivity for lower gastrointestinal injury [16] and should not be utilized indiscriminately after gunshot wounds to the pelvis [17].

Recent civilian evidence suggests that the combination of CT of the abdomen/pelvis and rigid proctoscopy is the new gold-standard for diagnosis of rectal injuries (Fig. 1A-B). In 2016, Schellenberg et al. investigated the various diagnostic modalities for rectal injury in patients with transpelvic gunshot wounds and reported both a sensitivity and negative predictive value of 100% for CT scan with IV contrast. CT findings suggestive of rectal injury include rectal wall abnormality/defect, perirectal stranding, and/or rectal wall thickening. Based on their conclusions, unless the patient meets criteria for immediate laparotomy, all patients with transpelvic gunshot wounds should undergo CT scan as the initial diagnostic test for rectal injury [17]. CT scan is poor at delineating the precise location of the rectal injury relative to the peritoneal reflection, a critical distinction for treatment decision-making. As a result, a diagnosis of rectal injury on CT scan should be followed by rigid proctoscopy to define the location of injury (intra- vs. extraperitoneal) if it is unclear. Trust et al. (2018) further clarified this diagnostic approach, by demonstrating a 97% sensitivity for blunt and penetrating rectal injuries when a combination of abdominopelvic CT and rigid proctoscopy were used [14]. If the location of a rectal injury relative to the peritoneal reflection remains unclear after CT scan and rigid proctoscopy, diagnostic laparoscopy can be performed to exclude an intraperitoneal component.

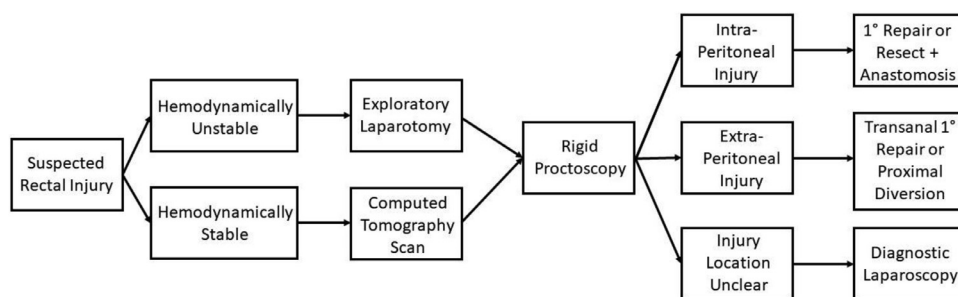


Fig. 2. Diagnostic and Treatment Algorithm for Suspected Rectal Injury.

Patients with suspected rectal injury who are hemodynamically unstable proceed directly to the operating room for hemorrhage control of associated injuries via exploratory laparotomy. Once achieved, proctoscopy is the next step in diagnosis of a rectal injury.

Hemodynamically stable patients undergo computed tomography scan as the initial investigation. Frequently, a rectal injury is suggested but not conclusively demonstrated and then proctoscopy is the next step in the diagnostic work-up. If computed tomography scan conclusively demonstrates a rectal injury, proctoscopy is still the next step in order to delineate the location of the injury relative to the peritoneal reflection.

If the rectal injury location is unclear after proctoscopy (intra- vs. extraperitoneal), a diagnostic laparoscopy can be performed to exclude an intraperitoneal component prior to injury management.

Management of intraperitoneal injuries is dictated by injury extent, with resection and anastomosis reserved for destructive injuries.

Management of extraperitoneal injuries is dictated by feasibility of transanal repair. Injuries that can easily be accessed transanally may be primarily repaired. Injuries that are not accessible are proximally diverted with a loop sigmoid colostomy.

1°, primary.

Management

Once a rectal injury is diagnosed and its relationship to the peritoneal reflection is defined, the specific management algorithms are straightforward. The treatment of rectal injuries is dictated by the intra- vs. extraperitoneal location of the injury, and not by injury mechanism.

Intraperitoneal injuries

Intraperitoneal rectal injuries from either blunt or penetrating trauma are managed in the same manner as colonic injuries [9,18,19]. Practically speaking, this treatment consists of injury debridement back to healthy tissue followed by primary repair. Particularly during primary repair of larger defects, care should be taken to close the injury in a transverse fashion in order to limit luminal narrowing and risk of stricture formation. Injuries are typically closed in two layers, with running absorbable suture (e.g. vicryl) for the inner layer and interrupted non-absorbable suture (e.g. silk) for the outer layer. Injuries too large for feasible primary repair and those associated with devascularization should be resected. Either hand-sewn or stapled anastomoses are acceptable, with care taken to avoid tension and ensure ample blood supply regardless of which technique is utilized. Proximal diversion of intraperitoneal rectal injuries does not improve outcomes and is not recommended [10].

Extraperitoneal injuries

Compared to intraperitoneal rectal injuries, the optimal management of injuries below the peritoneal reflection is more controversial. Recommended extraperitoneal rectal injury management has changed significantly over the past several decades and can generally be described as becoming progressively more minimalistic.

The first major step away from the classic 4 D's (direct repair, drainage, diverting colostomy, distal rectal washout) in civilian trauma was published by Burch et al. in 1989 and concluded that only diver-

sion and pre-sacral drainage were truly necessary [21]. These findings were later challenged, in a prospective randomized study by Gonzalez et al., which showed that pre-sacral drainage did not reduce infectious complications [22]. Most recently, pre-sacral drainage and distal rectal washout were shown to be significantly associated with increased intra-abdominal complications [10]. Therefore, contemporary literature recommends against pre-sacral drainage and distal rectal washout [10,15,19].

Based on the available evidence, extraperitoneal rectal injuries should be repaired primarily via a trans-anal approach when possible. If the injury is inaccessible trans-anally, the patient should be managed solely with proximal diversion in the form of a loop sigmoid colostomy [15,19,20]. Either a laparoscopic or open approach to colostomy creation is acceptable. The choice of technique should be guided by injury factors such as overall injury burden and the patient's physiologic status, as well as by surgeon preference and patient factors such as body habitus. Our approach to the diagnosis and treatment of rectal injuries is summarized in Fig. 2.

A particular subset of extraperitoneal rectal injuries warrant specific consideration. Rectal foreign bodies are a common emergency department presentation, although these retained objects rarely result in full-thickness injury to the rectum. When injuries do occur, they are typically extraperitoneal. Unless a full-thickness injury is conclusively demonstrated, nonoperative management and a period of observation is recommended over surgical intervention in those with rectal injuries due to foreign bodies [23].

Complications

Potential complications in patients with rectal injuries include infection, stenosis, and fistulae. Infective complications can range from abscesses to life-threatening infections, such as necrotizing soft tissue infections or perineal sepsis. Patients with associated open pelvic fractures are at particularly high risk for infectious complications and concern-

ingly, fecal diversion for these patients has not been shown to mitigate infection risk [24]. Clinicians must maintain a high degree of suspicion for infection after a rectal injury to ensure prompt intervention when required. Infection risk may be reduced with a short course of postoperative antibiotics but this has not been rigorously studied and the optimal duration of treatment is unknown. Anecdotally, we typically administer gram negative and anaerobic coverage for 3–5 days postoperatively for patients with extraperitoneal rectal injuries who have been diverted. For intraperitoneal rectal injuries, a 24-hour course of antibiotics postoperatively is likely sufficient.

The incidence or management of stenosis following rectal injury is not well delineated by existing literature. One study of colon and rectal injuries initially managed with colostomy demonstrated a 10% rate of major complications following colostomy reversal: one anastomotic stricture, one fistula, and two small bowel obstructions [25]. Extrapolating from elective surgery data, the risk of stenosis may be minimized by ensuring that the rectal lumen is widely patent after anastomosis or transversely-oriented primary repair. Care should also be taken to debride the rectum back to healthy, well-perfused tissue prior to repair or anastomosis. Mild symptoms may be self-limited as the rectal repair or anastomosis will dilate over time as the rectum resumes its normal functions. However, patients with severe or persistent symptoms may require serial dilations or even surgical revision.

Lastly, rectovesical and rectourethral fistulae can occur following rectal injury. These are most common among patients with combined rectal and genitourinary injuries. Intraoperatively, the risk of fistula formation in these patients may be minimized by placing an omental flap between the rectal and bladder repairs [26].

Remaining controversies

Despite the recent advances in rectal trauma management, there remain a number of controversies. Most provocatively, it is unclear if penetrating extraperitoneal injuries truly necessitate repair or diversion. Small extraperitoneal injuries, particularly those after stab wounds, may be amenable to nonoperative management with close clinical monitoring and antibiotic administration, with the injury left to heal by secondary intention. At the current time, this is largely speculative as the evidence supporting this approach is limited [27]. Rigorous scientific study will be needed to determine the safety of this management strategy as well as to delineate the appropriate patient population in the future before this approach can be formally recommended.

Lastly, there remains no consensus on the optimal timing for reversal of diverting colostomy for rectal injuries. The current literature supports loop reversal any time between the index hospitalization to more than three months after injury. Additional study is needed prior to consensus guidelines for colostomy reversal, which can be associated with high complication rates (5–25%) [28]. In practice, the timing of loop colostomy reversal following extraperitoneal rectal injury should be individualized based on patient factors, including nutritional status, clinical trajectory of associated injuries, and restoration of normal patient physiology.

Declaration of Competing Interest

The authors have no conflicts of interest or disclosures of funding to declare.

References

[1] Welling D, Duncan J. Stomas and trauma. *Clin Colon Rect Surg* 2008;21:045–52. doi:10.1055/s-2008-1055321.

- [2] Fraser J, Drummond H. A clinical and experimental study of three hundred perforating wounds of the abdomen. *Br Med J* 1917;1:321. doi:10.1136/bmj.1.2932.321.
- [3] Demetriades D. Colon injuries: new perspectives. *INJ* 2004;35:217–22. doi:10.1016/j.injury.2003.11.004.
- [4] Lavenson GS, Cohen A. Management of rectal injuries. *Am J Surg* 1971;122. doi:10.1016/0002-9610(71)90322-9.
- [5] Glasgow SC, Steele SR, Duncan JE, Rasmussen TE. Epidemiology of modern battlefield colorectal trauma. *J Trauma Acute Care* 2012;73:S503–8. doi:10.1097/ta.0b013e3182754759.
- [6] Steele SR, Wolcott KE, Mullenix PS, Martin MJ, Sebesta JA, Azarow KS, et al. Colon and rectal injuries during operation iraqi freedom: are there any changing trends in management or outcome? *Dis Colon Rectum* 2007;50:870–7. doi:10.1007/s10350-007-0235-4.
- [7] Lesperance K, Martin MJ, Beekley AC, Steele SR. The significance of penetrating gluteal injuries: an analysis of the operation iraqi freedom experience. *J Surg Educ* 2008;65:61–6. doi:10.1016/j.jsurg.2007.08.004.
- [8] Brown SR, Swisher JP, Hofmann LJ, Coviello LC, Davis KG. Surgical management and associated complications of penetrating rectal injuries sustained in Iraq and Afghanistan. *Mil Med* 2013;178:1213–17. doi:10.7205/milmed-d-13-00167.
- [9] Demetriades D, Murray JA, Chan L, Ordoñez C, Bowley D, Nagy KK, et al. Penetrating colon injuries requiring resection: diversion or primary anastomosis? An AAST prospective multicenter study. *J Trauma Inj Infect Crit Care* 2001;50:765–75. doi:10.1097/00005373-200105000-00001.
- [10] Brown CVR, Teixeira PG, Furay E, Sharpe JP, Musonza T, Holcomb J, et al. Contemporary management of rectal injuries at Level I trauma centers. *J Trauma Acute Care* 2018;84:225–33. doi:10.1097/ta.0000000000001739.
- [11] Moore EE, Cogbill TH, Malangoni MA, Jurkovich GJ, Champion HR, Gennarelli TA, et al. Organ injury scaling, 11. *J Trauma Inj Infect Crit Care* 1990;30:1427. doi:10.1097/00005373-199011000-00035.
- [12] Miller A., Brown C., Martin M. Anorectal trauma and injuries. In: *Fundamentals of anorectal surgery*. Vol. 3rd. Springer; 517–30
- [13] Gash KJ, Suradkar K, Kiran RP. Rectal trauma injuries: outcomes from the U.S. national trauma data bank. *Tech Coloproctol* 2018;22:847–55. doi:10.1007/s10151-018-1856-4.
- [14] Trust MD, Veith J, Brown CVR, Sharpe JP, Musonza T, Holcomb J, et al. Traumatic rectal injuries. *J Trauma Acute Care* 2018;85:1033–7. doi:10.1097/ta.0000000000002070.
- [15] Velmahos GC, Gomez H, Falabella A, Demetriades D. Operative management of civilian rectal gunshot wounds: simpler is better. *World J Surg* 2000;24:114–18. doi:10.1007/s002689910021.
- [16] Ahl R, Riddez L, Mohseni S. Digital rectal examination for initial assessment of the multi-injured patient: can we depend on it? *Ann Med Surg* 2016;9:77–81. doi:10.1016/j.amsu.2016.07.006.
- [17] Schellenberg M, Inaba K, Priestley EM, Durso J, Wong MD, Lam L, et al. The diagnostic yield of commonly used investigations in pelvic gunshot wounds. *J Trauma Acute Care* 2016;81:692–8. doi:10.1097/ta.0000000000001159.
- [18] McGrath V, Fabian TC, Croce MA, Minard G, Pritchard FE. Rectal trauma: management based on anatomic distinctions. *Am Surg* 1998;64:1136–41.
- [19] Navsaria PH, Edu S, Nicol AJ. Civilian extraperitoneal rectal gunshot wounds: surgical management made simpler. *World J Surg* 2007;31:1347–53. doi:10.1007/s00268-007-9045-z.
- [20] Bosarge PL, Como JJ, Fox N, Falck-Ytter Y, Haut ER, Dorion HA, et al. Management of penetrating extraperitoneal rectal injuries. *J Trauma Acute Care* 2016;80:546–51. doi:10.1097/ta.0000000000000953.
- [21] Burch JM, Feliciano DV, Mattox KL. Colostomy and drainage for civilian rectal injuries. *Ann Surg* 1989;209:600–11. doi:10.1097/0000658-198905000-00013.
- [22] Gonzalez RP, Falimirski ME, Holvear MR. The role of presacral drainage in the management of penetrating rectal injuries. *J Trauma Inj Infect Crit Care* 1998;45:656–61. doi:10.1097/00005373-199810000-00002.
- [23] Schellenberg M, Brown CVR, Trust MD, Sharpe JP, Musonza T, Holcomb J, et al. Rectal injury after foreign body insertion: secondary analysis from the AAST contemporary management of rectal injuries study group. *J Surg Res* 2019;247:541–6. doi:10.1016/j.jss.2019.09.048.
- [24] Lunsjo K, Abu-Zidan FM. Does colostomy prevent infection in open blunt pelvic fractures? A systematic review. *J Trauma Inj Infect Crit Care* 2006;60:1145–8. doi:10.1097/01.ta.0000197615.31553.1e.
- [25] Berne JD, Velmahos GC, Chan LS, Asensio JA, Demetriades D. The high morbidity of colostomy closure after trauma: further support for the primary repair of colon injuries. *Surgery* 1998;123(2):157–64. <https://pubmed.ncbi.nlm.nih.gov/9481401/>.
- [26] Pereira BM, Reis LO, Calderan TR, Campos CCde, Fraga GP. Penetrating bladder trauma: a high risk factor for associated rectal injury. *Adv Urol* 2014;2014:1–5. doi:10.1155/2014/386280.
- [27] Gonzalez RP, Phelan H, Hassan M, Ellis CN, Rodning CB. Is fecal diversion necessary for nondestructive penetrating extraperitoneal rectal injuries? *J Trauma Inj Infect Crit Care* 2006;61:815–19. doi:10.1097/01.ta.0000239497.96387.9d.
- [28] Chow A, Tilney HS, Paraskeva P, Jeyarajah S, Zacharakis E, Purkayastha S. The morbidity surrounding reversal of defunctioning ileostomies: a systematic review of 48 studies including 6,107 cases. *Int J Colorectal Dis* 2009;24:711. doi:10.1007/s00384-009-0660-z.