

Transforming the management of colon injury: Dr Timothy C Fabian – scholar, scientist, leader, and teacher

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SUMMARY

Dr Fabian and his colleagues have transformed the management of colon injury during a span of more than four decades. They have done so by following a patient-centered, rigorous, and dogged approach to improving patient care and standardizing care with a simplified and widely applicable algorithm. All non-destructive colon injuries are primarily repaired. Healthy patients without massive blood loss who have sustained destructive wounds are treated with resection and anastomosis without fecal diversion. Patients with coexisting significant medical conditions or those requiring greater than 6 units of packed red blood cell (PRBC) transfusions are treated with resection and fecal diversion. Following this simple algorithm has led to a low rate of anastomotic leak with minimal colon-related morbidity in penetrating and blunt colon trauma and in those patients requiring abbreviated laparotomy/damage control procedures.

During his four decades in Memphis, Dr Fabian established, led, and developed a regional trauma system which transformed trauma care, significantly improving survival and minimizing disability of patients in the Memphis community and across the entire mid-South region.

I was fortunate to be a trauma and surgical critical care fellow 30 years ago in Memphis. As a leader, Dr Fabian gave us the freedom to pursue our own interests and explore ideas with full academic freedom with only one caveat—always do the right thing for our patient. A general principle championed by Dr Fabian is that patient care is not a means to some other goal (academic, reputational, or financial); no, serving the patient's interests first is the reason we exist as surgeons and the reason why the trauma system exists. This human-centered approach was central to the Memphis approach to trauma care led by Timothy C Fabian and will live on in the work of those who are following his leadership.

Dr Timothy C Fabian first began his transformational work on the management of colon trauma as a fellow at Grady Memorial Hospital with his mentor Dr H Harlan Stone. The duo of Dr Stone and Dr Fabian ([figure 1](#)) designed and conducted a prospective, randomized trial in a select group of patients with perforating colon trauma.¹ This study was presented at the American Surgical Association and later published in the *Annals of Surgery* in 1979, providing the necessary evidence that primary repair of straightforward colon injuries was not only safe, but also those patients had improved

outcomes and fewer complications when compared with those managed by colostomy (the strongly established standard at the time).

After World War II, almost all colon wounds were treated with mandatory fecal diversion. The evidence for this practice had been extended from the wartime experience of US and British forces, initially from the North African campaign of 1942, which was later broadened to include all British and American forces. Exteriorized repair of the colon wound had some advocates in the USA, and there were reports of successful primary repair of colon wounds in civilian US practice. However, until this landmark trial, most surgeons in the USA still followed the clinical practice mandate of colostomy for all penetrating wounds to the colon. Dr Stone and Fabian's randomization was done by medical record number. In the operating room, once bleeding control had been obtained and visceral contamination was controlled, a set of seven exclusion criteria were assessed, and if any of these criteria existed, the patient was treated with colostomy by exteriorization of the wound or proximal fecal diversion by loop ostomy creation. The seven criteria for obligatory colostomy or fecal diversion were defined as (1) shock-preoperative with BP of <80/60 mm Hg, (2) hemorrhage with intraperitoneal blood loss of >1,000 mL, (3) organs greater than two organ systems injured, (4) contamination-significant peritoneal soilage by feces, (5) time operation began >8 hours after injury, (6) colon wound so destructive as to require resection, and (7) abdominal wall loss of major substance/requiring mesh replacement. During a period of 44 months, 268 patients sustained perforating colon injury. Of those patients, 129 met criteria for obligatory



Figure 1 Dr H Harlan Stone (center), Dr Timothy C Fabian (right), and Denise Fabian (left), 2015.

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Table 1

Authors	Study	Findings
Stone and Fabian ¹	Management of perforating colon trauma: randomization between primary closure and exteriorization. <i>Ann Surg.</i> 1979;190(4):430–6.	Randomized clinical trial demonstrated a clear benefit of primary repair over fecal diversion in a select group of lower-risk patients with colon injuries.
George <i>et al</i> ²	Colon trauma: further support for primary repair. <i>Am J Surg.</i> 1988;156(1):16–20.	This is a 5-year retrospective review of colon repair during Dr Fabian's first 5 years at Memphis. There were no suture line leaks and the authors concluded with 'Primary repair of all colon wounds not requiring resection may be feasible. Prospective evaluation of that approach is indicated'.
George <i>et al</i> ³	Primary repair of colon wounds. A prospective trial in nonselected patients. <i>Ann Surg.</i> 1989;209(6):728–33; 33–4.	Dr George and colleagues conducted a prospective review of all colon injuries (102). There were no leaks in the primary repair group and one leak in the resection and anastomosis group regardless of risk factors. They concluded that nearly all penetrating colon wounds can be repaired primarily or with resection and anastomosis.
Poret <i>et al</i> ⁴	Analysis of septic morbidity following gunshot wounds to the colon: the missile is an adjuvant for abscess. <i>J Trauma.</i> 1991;31(8):1088–94;discussion 94–5.	This retrospective review by Dr Poret and colleagues demonstrated that there are a group of patients who develop abscesses related to the retained missile and that these abscesses were difficult to resolve without removal of the ballistic fragment. They conclude 'a reasonable attempt at bullet extraction should be made following colonic wounding'.
Stewart <i>et al</i> ⁵	Is resection with primary anastomosis following destructive colon wounds always safe? <i>Am J Surg.</i> 1994;168(4):316–9.	This study reviewed all destructive colon wounds requiring resection and anastomosis. The anastomotic failure rate was 14%. In patients with transfusion of >6 units of PRBC or significant medical condition, the risk of anastomotic leak was 42%, whereas in previously healthy patients with less than 6 units of blood transfused, the risk of leak was 8%. This led to a simplified management algorithm.
McGrath <i>et al</i> ⁶	Rectal trauma: management based on anatomic distinctions. <i>Am Surg.</i> 1998;64(12):1136–41.	McGrath and colleagues reviewed rectal injuries based on the anatomic level of injury and recommended intraperitoneal rectal wounds can be treated with repair similar to colon wounds, and the upper two-thirds of extraperitoneal rectal wounds could be repaired with or without diversion and do not require presacral drainage. Lower rectal wounds that can be repaired do not require presacral drainage, but those not repaired should have presacral drainage repaired with diversion.
Maxwell and Fabian ⁷	Current management of colon trauma. <i>World J Surg.</i> 2003;27(6):632–9.	Drs Maxwell and Fabian prepared a comprehensive review of colon trauma from World War I until 2003. They comprehensively cover colon trauma. They describe areas with well-defined standards of care and outline the less well-defined areas, making recommendations for research in these areas of controversy.
Weinberg <i>et al</i> ⁸	Penetrating rectal trauma: management by anatomic distinction improves outcome. <i>J Trauma.</i> 2006;60(3):508–13;discussion 13–14.	This clinical pathway described by Weinberg <i>et al</i> builds on the previous article by Dr McGrath. It describes a very clear clinical practice guideline for rectal injuries: Intraperitoneal wounds can be managed by primary repair, extraperitoneal wounds in the upper two-third segment managed by repair or resection and anastomosis with or without fecal diversion based on surgeon judgment. The lower one-third are managed by primary repair if accessible with proximal diversion and if not accessible fecal diversion with presacral drainage.
Hargraves <i>et al</i> ⁹	Injury location dictates utility of digital rectal examination and rigid sigmoidoscopy in the evaluation of penetrating rectal trauma. <i>Am Surg.</i> 2009;75(11):1069–72.	This retrospective review examined the diagnostic utility of DRE and rigid proctoscopy. Sensitivity for DRE was 51% and for rigid proctoscopy 78%. As neither was 100%, an exploration is recommended if suspicion is high even with a negative DRE and proctoscopy.
Sharpe <i>et al</i> ¹⁰	Adherence to a simplified management algorithm reduces morbidity and mortality after penetrating colon injuries: a 15 year experience. <i>J Am Coll Surg.</i> 2012;214(4):591–7;discussion 7–8.	The next article is one of a series written by Sharpe <i>et al</i> clearly defining a simplified management algorithm for all colon injuries. In this article, they conclude that all non-destructive penetrating colon wounds can be primarily repaired. The majority of those requiring resection can be reconstructed without diversion, except for those requiring transfusion of >6 units of PRBCs and/or those who have significant comorbidities.
Sharpe <i>et al</i> ¹¹	Impact of location on outcome after penetrating colon injuries. <i>J Trauma Acute Care Surg.</i> 2012;73(6):1428–32;discussion 33.	Related to the aforementioned and subsequent articles, the authors define that anatomic location of the colon wound did not affect mortality or morbidity. Non-destructive wounds should be repaired primarily. Operative decisions regarding wounds requiring resection should be based on a defined algorithm and not on anatomic location of the colon injury.
Sharpe <i>et al</i> ¹²	Applicability of an established management algorithm for colon injuries following blunt trauma. <i>J Trauma Acute Care Surg.</i> 2013;74(2):419–24;discussion 24–5.	The authors reviewed 151 blunt colonic injuries and conclude that the simple management algorithm for penetrating colon injuries is applicable to blunt colon injuries: primary repair for non-destructive colon wounds, resection, and anastomosis without diversion for healthy patients receiving less than or equal to 6 units of PRBC, resection with diversion for those with a comorbidity or massive transfusion.
Sharpe <i>et al</i> ¹³	Applicability of an established management algorithm for destructive colon injuries after abbreviated laparotomy: a 17 year experience. <i>J Am Coll Surg.</i> 2014;218(4):636–41.	In this article, the Memphis group reviewed severely injured trauma patients who were treated with abbreviated laparotomy/damage control. They compared patients who had resection with delayed anastomosis after abbreviated laparotomy and examined the results of patients where the simplified algorithm was followed versus not followed. Where the algorithm was followed, the suture line failure was 4%, whereas in the patients where the algorithm was not followed, the suture line failure was 32% (p=0.03). Sharpe and colleagues conclude that adherence to their established algorithm is effective for those undergoing abbreviated laparotomy/damage control.
Sharpe <i>et al</i> ¹⁴	Evolution of the operative management of colon trauma. <i>Trauma Surg Acute Care Open.</i> 2017;2(1):e000092.	In this review article, Sharpe <i>et al</i> provide a comprehensive review of their evolution of operative management of colon trauma. This article describes their development and application of their simplified algorithm. They review the rationale, outcomes, and benefits of this approach in managing the full spectrum of colon injury.
Manley <i>et al</i> ¹⁵	Analysis of over 2 decades of colon injuries identifies optimal method of diversion: Does an end justify the means? <i>J Trauma Acute Care Surg.</i> 2019;86(2):214–9.	Manley and colleagues reviewed two decades of patients sustaining colon injuries who were treated with ostomy. In those without planned ventral hernia, a loop ostomy had significant benefits when compared with an end ostomy: shorter operative times, length of stay and lower complications. They recommend loop ostomy as the preferred technique for fecal diversion.

DRE, digital rectal examination.



Figure 2 Dr Timothy C Fabian, Washington DC, developing National Trauma Research Action Plan, 2017.



Figure 5 Dr Timothy C Fabian, San Antonio, Texas, 2016, Basil A. Pruitt, MD Festschrift.



Figure 3 Dr Timothy Fabian and Mrs Denise Fabian, June 12, 2015, Harwell Wilson Surgical Society, Memphis, Tennessee.



Figure 6 Timothy and Denise Fabian, Harwell Wilson Surgical Society, Memphis, TN (Dr Martin Croce and Jackson Stewart photobombing).

colostomy, while 139 were able to be randomized. Primary closure was performed in 67 of the patients and 72 patients underwent colostomy. Not surprisingly, the obligatory colostomy group had a greater frequency of firearm-related injury, a greater blood loss and resuscitation requirements, a greater severity of injury, a longer time duration to treatment, and an increased mortality (15% obligatory colostomy vs. 1% in both randomized groups) when compared with the obligatory colostomy group.



Figure 4 Dr Timothy C Fabian and Dr Martin A Croce, San Antonio, Texas, 2016, Basil A Pruitt, MD Festschrift.

In comparing the patients who were randomized, those treated by colostomy had a longer hospital stay, a greater surgical site infection rate, and greater hospital-related costs when compared with the primary repair group. At the time of the publication, 62 of the 72 patients (86%) randomized to colostomy had undergone ostomy reversal. The mean hospital stay for that second operation was 11 days, and there was one death from pulmonary embolus after the closure of the colostomy.

This landmark clinical trial by Drs Stone and Fabian clearly demonstrated a benefit of primary repair over fecal diversion in a select group of lower risk patients with colon injuries. This trial led to a large practice change with respect to colon injuries in the USA. I was a witness of this change during my time (1981–1991) as a medical student and resident at University Hospital in San Antonio. In the beginning of my time as a medical student, until my chief resident year, we transitioned from mandatory colostomy to selective colostomy based on Dr Stone and Fabian's criteria. From a distance, we, like the group in Memphis and many academic trauma programs, had begun to assess those seven criteria defined by Stone and Fabian to determine which of those criteria were truly relevant to the outcome of patients with perforating colon trauma, asking the question, 'Which wounds (if any) required initial colostomy rather than primary repair?' Dr Fabian and the team of surgeons at Memphis would



Figure 7 Dr Timothy C Fabian and Dr Frances Elizabeth Pritchard, Harwell Wilson Surgical Society, Memphis, TN, 2015.



Figure 8 Dr Martin A Croce, Dr Kimberly Davis, and Dr Timothy C Fabian, San Antonio, Texas, 2016, Basil A Pruitt, MD Festschrift.



Figure 9 Dr Timothy C Fabian, National Trauma Institute, Dallas, Texas, 2016.

play a leading role in answering this question during the next 30 years²⁻¹⁵ (table 1).

I first met Dr Fabian in 1990, when I interviewed for the Surgical Critical Care and Trauma Fellowship at the University of Tennessee Health Science Center's Trauma Division in the Department of Surgery. In 1990, Dr Fabian was the Trauma Division Chief, having taken the position at the University of Tennessee Medical School in Memphis about a decade earlier. As we all know now, he would later become the Chair of the Department of Surgery in Memphis in 1999, where he served in that role for 15 years. When we first met, he and a small group of surgeons had led the development of a regional trauma system in the four-state area around Memphis with 'The Med' and its Elvis Presley Memorial Trauma Center as the central regional trauma center hub. Dr Fabian was there from the beginning and led the transformation into a true regional system. Dr Fabian is a great program builder and was an early architect of this regional trauma system, which is located at a critical geographical location which includes one of the most diverse, dynamic and underserved regions in the country. Dr Fabian had studied trauma systems, and he intuitively seemed to understand that it was very important to build a *regional* trauma center and a regional trauma system. He instinctually knew that this was important for our patients, and for the well-being of the hospital and community we were serving, important from a clinical, financial, and humanistic standpoint. It is ironic that as a young fellow in Memphis, trauma system development (which would later become my life's work) initially seemed dry and boring to me. However, because Dr Fabian thought it was important, I paid attention and was receptive to the way he thought about developing trauma systems. His influence changed my professional life and my interests.

Dr Fabian is a true scholar. A scholar about medicine and surgery yes, but also a true scholar about life and its goings-on. He has broad interests and is a great thinker in both a philosophical and a technical sense (figure 2). I had the great privilege to work with him and the great team at Memphis at a unique period. This was a time that the foundation was established (Dr Fabian had been there about 10 years), but also a time when the academic trauma program, the trauma center, and the trauma system were still being built and developed on this foundation. I think I was the third trauma fellow at Memphis, so it was all pretty new, and to some degree, we were making up the rules and norms of the program when I was there. I did the 2-year fellowship and loved every single minute of the experience. Dr Fabian is not a micromanager. He really allowed me (and all of us) a great deal of freedom to pursue our own interests and explore ideas with full academic freedom with only one caveat—do the right thing for our patient. I was on call my first night of starting the fellowship, and it was immediately clear, and is still clear to me today that Dr Fabian really cares about all our patients as individual human beings. A general principle championed by Dr Fabian is that patient care is not a means to some other goal (academic, reputational, or financial); no, serving the patient's interests first is the reason we exist as surgeons and the reason why the trauma system exists. This human centered approach was central to the Memphis approach to trauma care led by Timothy C Fabian. So, relative to management of colon injury, when I arrived, the entire team was working on the hypothesis that repairing all colon wounds primarily or with resection and anastomosis was feasible and may be best for trauma patients. As I write this, I realize some think this is the optimum management of colon trauma today. In the years around my time in Memphis, this was beginning to be the standard clinical practice of our

team,^{2,3} but to be true to the Memphis approach pioneered by Dr Fabian, we would commit to a detailed review of our results with any significant change in practice. Therefore, I was encouraged to review the results of this approach—repair of all colon wounds with either primary repair or resection and anastomosis. Previous reviews had demonstrated that regardless of the seven previously defined criteria, primary repair was virtually uniformly successful in non-destructive (wounds not requiring resection) so, we reviewed our experience with the high-risk group of destructive colon wounds requiring resection and anastomosis. Surprisingly, we found in a group of unselected patients requiring resection and anastomosis, the anastomotic failure rate was 14%. Operating on the hypothesis that healing an anastomosis is dependent on a healthy blood supply and healthy immune function, we examined the risk factors of massive transfusion and significant preinjury medical conditions such as cirrhosis, immunosuppression, or diabetes. In patients with either of these risk factors, the risk of anastomotic leak was 42%, whereas in previously healthy patients with less than 6 units of blood transfused, the risk of leak was 8%. This led to a clinical practice guideline which follows a simplified algorithm for operative decision making. Non-destructive wounds are all repaired primarily. For healthy patients without massive transfusion who have sustained destructive colon wounds, resection and anastomosis are recommended, but for those with significant medical illness or massive transfusion, resection with proximal diversion is recommended. This simple selective approach for destructive colon wounds leads to repair of almost all injuries except for the highest-risk group, who are treated with resection and diversion. This simple algorithm has held up during approximately three decades across the full spectrum of penetrating and blunt colon trauma and for those with and without damage control, or abbreviated laparotomy.

Sharpe *et al* have reviewed the results of this simplified management algorithm, which has led to primary reconstruction of 96% of colon injuries with a decreasing colon-related complication rate over time in both penetrating, blunt trauma and after abbreviated laparotomy with delayed anastomosis.^{10–15}

Dr Fabian and the Memphis team reviewed, assessed, and developed a straightforward algorithm for operative management of rectal injury: Most wounds in the intraperitoneal rectum can be treated similarly to colon injury, by primary repair without diversion. Extraperitoneal wounds in the upper two-thirds of the rectum are managed by repair or resection and anastomosis with or without fecal diversion based on surgeon judgment. Injuries in the lower one-third of the rectum are managed by primary repair if accessible with proximal diversion and, if not accessible, then fecal diversion with presacral drainage.^{6–9}

Lastly, the Memphis group has reviewed and developed recommendations on the optimal choice of the type of ostomy based on two decades of experience. For that small group of patients requiring diversion based on the simplified colon trauma algorithm or patients with complex rectal wounds described above, the preferred diversion technique is with a loop ostomy, due to shorter operative times, length of hospital stay, and fewer complications.¹⁵

During more than four decades, Dr Timothy C Fabian and his team of surgeons have led a revolution in the management of colon injury, which has dramatically improved the care of our patients. Dr Fabian and his team have done this by following a patient-centered, rigorous, and dogged pursuit of improving patient care and standardizing care with a simplified and widely applicable management algorithm.

REMEMBERING OUR TIME IN MEMPHIS

Dr Fabian is one of the most human of all the surgical leaders I know. He and Denise are so kind, so wise, and so friendly. What I remember the most is we (Sherri, Elizabeth, our 6-month-old daughter, and I) became a part of their extended family. We had routine dinners with Dr Fabian, Denise, and their children, which always included the faculty, residents, and all our families. I remember making homemade ice cream and spending time with Dr Fabian, Denise, Martin, Liz, Gayle, Ken, and the whole team of amazing characters (figures 3–8). Dr Fabian is simultaneously comfortable being informal and formal. He seems perfectly at home either in bowtie or a t-shirt, and he shares profound wisdom in a simple and straightforward manner (figure 9). I think, or at least I hope, I came to Memphis as a well-trained surgeon, but I left there a better human being and a much more complete surgeon. I still vividly remember those days, as if they were a few months ago, and I am forever grateful.

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