

# TITAN CSR: a new self-retaining retractor for abdominal surgery

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## ABSTRACT

**Background** Self-retaining retractors provide hands-free exposure and allow surgeons to use their hands to perform surgery rather than manually retract tissues. Non-table-mounted retractors offer rapid assembly, but they have been traditionally limited in their ability to provide adequate exposure of the abdomen. Table-mounted retractors provide excellent exposure, but their cumbersome and time-intensive assembly often precludes their use in emergency settings. The TITAN CSR surgical retractor is a novel, lightweight, expandable, and modular system which offers the benefits of both designs by providing rapid assembly and effective abdominal exposure without a table attachment. We describe our experience with this new retractor system.

**Methods** Retrospective case series of selected trauma and emergency surgery laparotomies at an urban academic level 1 trauma center using the TITAN CSR surgical retractor during a 1-year period.

**Results** The TITAN CSR surgical retractor was used to provide exposure for trauma and emergency surgery laparotomies in both adult and pediatric patients in 89 cases from July 2021 to July 2022. Without requiring a table attachment, the TITAN CSR retractor provided hands-free surgical exposure during a variety of procedures including traumatic hysterectomy, gastrorrhaphy, enterorrhaphies and colectomy. With the added utility of attaching Bookwalter-compatible retractor blades, it provided effective exposure of retroperitoneal structures. These structures included the inferior vena cava, left femoral vessels, and duodenum. All laparotomies presented were successfully completed without setting up a post or a connection to the surgical table.

**Discussion** The TITAN CSR surgical retractor was successfully used in a number of difficult trauma and emergency surgery laparotomies, providing effective intra-abdominal and retroperitoneal exposure without necessitating an attachment to the surgical table. This retractor has the potential to replace current retractor systems in abdominal surgery, providing the benefits of table-mounted and non-table-mounted designs while removing their various disadvantages.

## BACKGROUND

An important principle of abdominal surgery is the concept of traction and countertraction to provide adequate exposure and create optimal access to areas of injury or disease. To achieve this, self-retaining metal retractors are frequently

used to separate the edges of the incision and expose abdominal and retroperitoneal structures in a hands-free manner.<sup>1 2</sup> The choice of retractor typically depends on the given procedure, the surgeon's preference, availability, cost, assistant availability, and overall experience. In general, self-retaining retractors are appealing because they enable operations to proceed with fewer assistants.<sup>3</sup>

There are multiple self-retaining retractor options available to contain tissues and gain exposure and access. In general, self-retaining retractors can be categorized into two groups: table-mounted and non-table-mounted. Traditional non-table-mounted retractors, such as the Balfour retractor, lack the ability to expose deep or retroperitoneal structures despite providing the benefit of speed and rapid initial assembly. Table-mounted retractors (Bookwalter, Thompson, Omni, etc) provide excellent exposure, but the assembly can be cumbersome and time-intensive which precludes their use in emergency settings (table 1).<sup>1</sup> Surgeons are therefore often forced to choose between rapid assembly or adequate exposure when selecting retractors, at times leading to multiple retractor changes, longer operating room (OR) times, and potentially inadequate exposure during critical settings.

The TITAN CSR surgical retractor is a self-retaining, lightweight, adjustable, and non-table-mounted system which integrates the best attributes of established retractor technologies into one novel design, providing optimal surgical exposure without requiring a table attachment (figure 1). Four abdominal wall retractor blades are connected to two interacting ring segments, expanding the abdominal incision (similar to a Balfour retractor) but also creating a supporting frame over the incision. Bookwalter-compatible retractor blades can then be attached to the overlying frame, allowing hands-free exposure of abdominal tissues including retroperitoneal structures. However, as opposed to the Bookwalter system, the TITAN CSR retractor does not require a table attachment.

We describe our use of the TITAN CSR retractor in trauma and emergency surgery procedures at a level 1 academic trauma center including adult and pediatric patients. These cases display its rapid assembly and use in cases where expeditious exposure is required.

## CASE PRESENTATION

1. A man in his 50s presented after a gunshot wound (GSW) to the abdomen resulting in a

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**Table 1** Weight comparison between equivalent TITAN CSR retractor and Bookwalter setup

	TITAN CSR retractor (lbs)	Bookwalter retractor (lbs)
Ring frame	1.1	1.0*
Retractor blade connector ×4†	0.5	0.9
Retractor blade ×4‡	0.5	1.5
Vertical table post	N/A	4.8
Horizontal post	N/A	2.6
Post coupling	N/A	1.1
Total weight (lbs)	2.2	11.9

Measurements provided by Advanced Surgical Retractor Systems.

\*Standard oval Bookwalter ring.

†Standard Bookwalter ratchet.

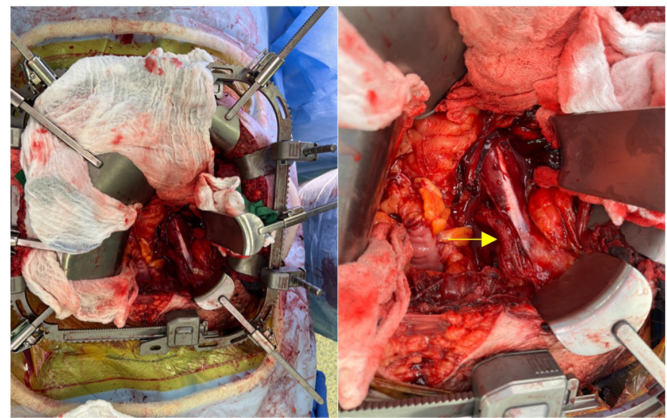
‡Medium 3" Richardson Bookwalter blades.

N/A, not applicable.

- large abdominal wall hernia with evisceration. CT scan revealed multiple ballistic fragments throughout the abdomen, many of which were within loops of small and large bowel. Some fragments were also in close proximity to the left iliac vessels. He underwent emergent celiotomy with repair of multiple enterotomies, segmental small bowel resection, sigmoidectomy, and exploration of the left common iliac vessels ([figure 2](#)) which were found to be uninjured.
- A young pregnant female patient presented in shock after a motor vehicle collision (MVC). She was hypotensive on arrival and transiently responsive to whole blood transfusion. On examination, she was found to have vaginal bleeding, no fetal heart tones or fetal movement on ultrasound, and her focused assessment with sonography for trauma examination was positive. Due to persistent hypotension and concern for uterine rupture and intrauterine fetal demise, she was taken emergently to the OR where she underwent supracervical hysterectomy and bilateral salpingectomy, requiring 25 units of whole blood ([figure 3](#)).
  - A man in his early 20s presented after a GSW to the abdomen. On arrival, he was hemodynamically normal and was found to have small bowel evisceration. He underwent exploratory laparotomy with left medial visceral rotation, gastrorrhaphy of anterior and posterior stomach, proximal jejunum enterotomy repair, and temporary abdominal closure ([figure 4](#)).



**Figure 1** TITAN CSR surgical retractor. Left image: retractor in contracted state, prepared for insertion into abdominal incision. Right image: retractor fully expanded. The four abdominal wall retractors are designed to move the wound edges out of the operative field (similar to a Balfour retractor), and the supported overlying ring allows the option for secondary retractor blade attachments for maximum exposure (similar to Bookwalter retractor functionality), but without an attachment to the surgical table.



**Figure 2** Exposure of left common femoral vessels using TITAN CSR surgical retractor. Left image: retractor expanded in abdomen and bowel retracted cephalad behind white laparotomy sponges using Bookwalter-compatible blades connected to TITAN CSR retractor frame. There is no attachment of the retractor to the surgical table. Right image: close-up of left image exposing left femoral artery (arrow) using Bookwalter-compatible Richardson blades connected to the TITAN CSR retractor frame.

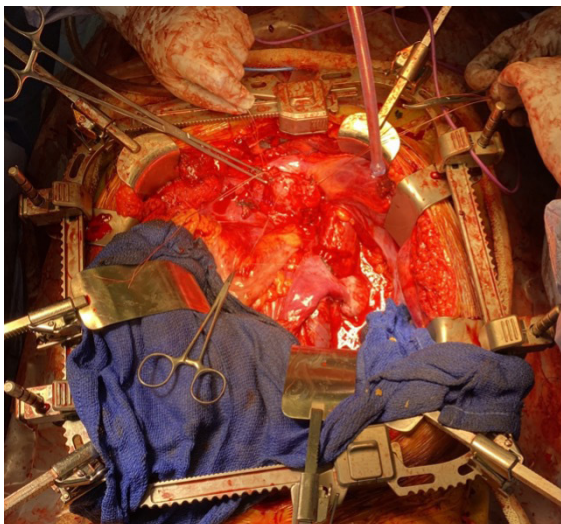
- A male adolescent presented with multiple GSWs to the abdomen and bilateral upper and lower extremities. He was taken for emergent exploratory laparotomy including exposure of the inferior vena cava and found to have multiple gastrotomies that were repaired primarily ([figure 5](#)).
- A male teenager status post-MVC restrained passenger presented with a positive seat belt sign and abdominal tenderness. CT scan was remarkable for free fluid and wall thickening of the small bowel. During exploratory laparotomy, he was found to have a bucket-handle injury to the terminal ileum extending to the ileocecal valve and compromising the ileocolic pedicle. Additionally, there was a bucket-handle injury to the proximal sigmoid colon. He underwent right hemicolectomy with ileocolonic anastomosis, as well as sigmoidectomy with colocolonic anastomosis.
- A restrained female driver in her early 20s presented after a single vehicle collision against a barrier. After initial evaluation and resuscitation, she underwent exploratory laparotomy and was found to have a perforation of the second portion of the duodenum and multiple colonic serosal injuries; the duodenum was repaired primarily with wide drainage ([figure 6](#)).

## DISCUSSION

Surgical retractors are essential in creating an optimal surgical field with proper exposure of tissues so the surgeon can perform the operation safely. Self-retaining retractors are frequently used due to their ability to provide hands-free exposure of the surgical field, facilitating the procedure, and minimizing the number of assistants which may be otherwise required.<sup>1</sup> There are multiple choices available, each type providing benefits but also individual limitations. Some designs have multiple complicated parts and take significant time to assemble, and others lack the ability to provide effective exposure of the abdominal cavity. As a result, these difficulties have generated new inventions to overcome these challenges and to provide better visibility during surgery, a goal which is beneficial to both the surgical team and the patient.

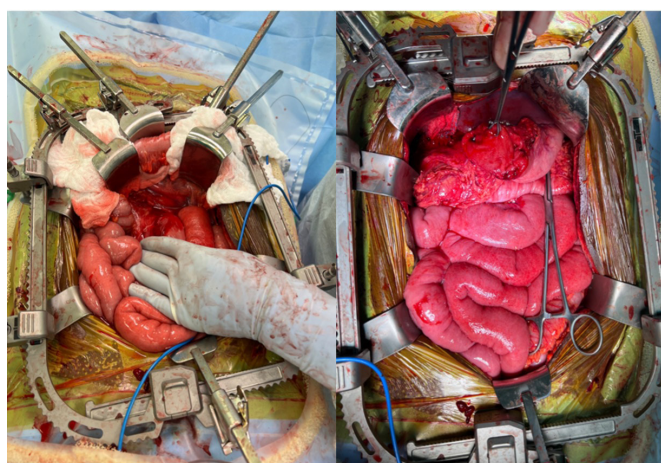
In the USA, the most common table-mounted retractor is the Bookwalter system, introduced in 1979 and now established



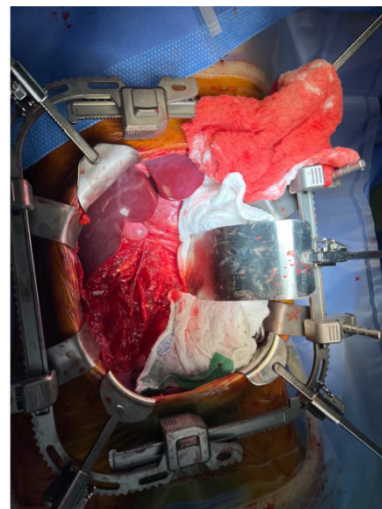


**Figure 3** Exposure of pelvis using TITAN CSR surgical retractor (view from head of bed towards feet). Retractor expanded in abdomen and bowel retracted cephalad behind blue towels using malleable Bookwalter-compatible blades connected to TITAN CSR retractor frame. There is no attachment of the retractor to the surgical table. Image is post-hysterectomy prior to surgical closure of cervical cuff.

as standard equipment in most ORs.<sup>3</sup> Consisting of multiple heavy components including a vertical post which connects to the surgical table, a horizontal connector, and a fixed ring, it is a cumbersome system which requires time-intensive assembly. Although effective in providing exposure, its complicated design can take up valuable time in the OR during assembly and disassembly. Another commonly used self-retaining retractor is the Balfour retractor, a 100+-year-old device which does not require connection to the surgical table. Invented in 1912, it is a combination of the Gosset and Doyen retractors and relies



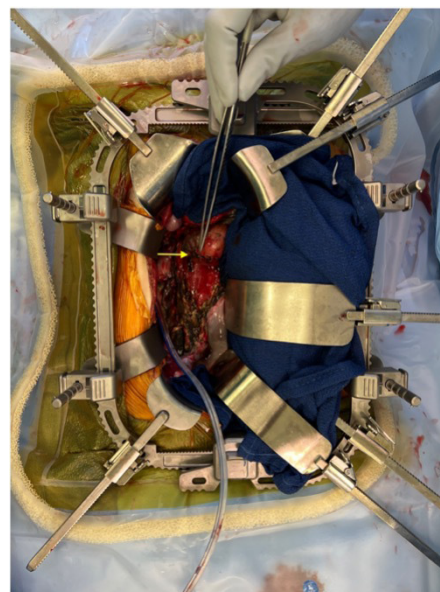
**Figure 4** Exposure of jejunum and stomach using TITAN CSR surgical retractor. Left image: retractor expanded in abdomen and transverse colon retracted cephalad behind two Richardson-type Bookwalter-compatible blades connected to TITAN CSR retractor frame. This provided effective exposure of the proximal jejunum and allowed repair of gunshot wound (GSW) enterotomies. There is no attachment of the retractor to the surgical table. Right image: exposure of GSW gastrotomies by retracting upper abdominal wall using Bookwalter-compatible blades attached to TITAN CSR retractor frame. Gastrotomies were repaired primarily.



**Figure 5** Exposure of retroperitoneum and inferior vena cava (IVC) using TITAN CSR surgical retractor. Retractor expanded in abdomen engaging abdominal wall, and right colon and duodenum retracted medially using single large malleable-type Bookwalter-compatible blade connected to TITAN CSR retractor frame. This hands-free exposure allowed exploration of the IVC and retroperitoneum without an attachment to the surgical table.

on countertraction. It consists of two broad and curved blades mounted on a ratchet mechanism with a central blade that pushes apart to open up the incision. The ratchet system locks the blades to stay in fixed position.<sup>4,5</sup> Despite providing rapid assembly, the Balfour is limited by poor exposure of deep or retroperitoneal structures.

The TITAN CSR is a post-free, self-retaining retractor that provides the advantages of the Bookwalter and Balfour retractors



**Figure 6** Exposure of duodenum using TITAN CSR surgical retractor. Retractor expanded in abdomen engaging abdominal wall, and small bowel and right colon retracted medially (behind blue towel) using two malleable-type Bookwalter-compatible blades connected to TITAN CSR retractor frame. Tip of instrument depicts suture line at second portion of duodenum after repair (arrow). No table attachment was required for this exposure.

but eliminates their individual limitations. In essence, it provides the speed of the Balfour and exposure of the Bookwalter in a non-table-mounted device. It is made from titanium, which is 40% lighter than stainless steel and holds retraction firmly and efficiently once it is applied, allowing hands-free exposure without a table attachment. When compared with the above-mentioned retractors, it has additional benefits including less time to assemble as well as fewer parts to function. In addition, it offers the option to attach Bookwalter-compatible accessory retractor blades, allowing exposure of retroperitoneal structures. As these accessory components are typically available in most ORs, this avoids the expense of purchasing additional parts but still allows additional retraction options.

In this brief report, we describe the successful use of the TITAN CSR retractor in a variety of trauma and emergency surgery procedures, many of which involved challenging injuries. Despite not being attached to the surgical table, this retractor provided exposure comparable with table-mounted systems but in a much faster time period, allowing quicker access to critical structures. Various deep and retroperitoneal exposures which would typically mandate use of a table-mounted system were easily generated, saving time, improving OR workflow, and overall increasing OR efficiency.

Currently, OR efficiency has become an important consideration in most healthcare facilities,<sup>6,7</sup> and the TITAN CSR offers various benefits in this regard. Since no table attachment is needed, the TITAN CSR eliminates post-related obstructions, decreasing the risk of sterile field contamination during setup and allowing the surgical team improved access to the surgical field. Additionally, a circulating nurse is not required for retractor setup, allowing more efficient use of busy OR personnel. With fewer parts for the surgical assistant to count and assemble compared with table-mounted systems, the TITAN CSR saves valuable time in the OR during assembly and disassembly. Interestingly, as a result of its modular construction, the TITAN CSR can be assembled around the surgeon's hands when manually controlling life-threatening hemorrhage to facilitate exposure in a critical setting, an option not available with table-mounted designs. These various benefits have the potential to improve OR efficiency as well as surgeon experience, staff satisfaction, and patient safety.

With its smaller size and weight compared with other retractor systems, the TITAN CSR has the potential to be extremely valuable to deployed military and humanitarian operations where transportation of weight and cube of any material is a critical issue. In addition, since many OR beds in this environment do not have mounting architecture for bed-mounted retractor systems, its functionality as a self-retaining retractor system would maximize its utility in these circumstances.

## CONCLUSION

In this report, we present a series of cases describing successful use of the TITAN CSR surgical retractor to gain exposure and visibility during abdominal surgery. This retractor provided rapid setup and effective exposure without requiring a table attachment, allowing quick access to the abdomen during emergency procedures. As a result of its faster assembly compared with table-mounted systems while providing equivalent exposure, this retractor has the potential to reduce time in the OR and improve overall efficiency. We have used this retractor now for over a year and conclude that the use of the TITAN CSR is safe and effective in gaining optimal exposure in abdominal surgery, and due to its various benefits, it has the potential to become the new retractor standard.

**Contributors** EPB performed literature review, acquisition of data, selection and analysis of the cases and writing of the article. BE contributed to editing and critical revisions of the article.

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**Competing interests** The retractor is used as standard of care at the discretion of the physicians, without monetary or other incentives for use. BE has an ongoing financial relationship with Advanced Surgical Retractor Systems. Article publishing fees paid by Advanced Surgical Retractor Systems.

**Patient consent for publication** Not required.

**Ethics approval** This study involves human participants but our Institutional Board (UT Health San Antonio IRB) exempted this study because it is not regulated research as defined by DHHS regulations at 45 CFR 46 and FDA regulations at 21 CFR 56 (protocol number: 20230165NRR).

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