

Wide-Span Balloon Retractor (“Laprotract”)

Narrative

I. ABSTRACT

A inflatable balloon retractor for minimally invasive surgery is described. The retractor consists of a triple-headed balloon which provides a much wider footprint than any other laparoscopic retractor, which will improve the ability of the surgeon to retract intestines or other large, unwieldy organs.

II. BACKGROUND

Minimally invasive surgical procedures upon the abdomen involve the manipulation of intraabdominal organs with long instruments inserted through transabdominal ports, as monitored with a similarly-placed videoscope (laparoscope). The complexity and size of the surgical instruments are limited by the diameter of the access ports (trocars), which generally should not exceed 12-15 mm so that the advantages of the minimally invasive approach can be realized. In some instances, such as with bowel retraction, this diameter restriction is a problem, because it is difficult to sweep, confine, or otherwise retract loops of intestine with a long instrument which only has a diameter of 10-11 mm. This particular problem has been addressed by some manufacturers which have produced retractors that can extend their dimensions after insertion into the abdomen. An example of such a commercially-available retractor is the Soft-Wand™ balloon retractor, shown in Figures 1-3.

The Soft-Wand™ (Gyrus ACMI) consists of inflatable/deflatable balloon mounted at the end of metal shaft. At the shaft end opposite to the balloon is a Luer-Lok™ fitting that accommodates a 20 cc syringe, which is used to inflate and deflate the balloon. The surface of the balloon is covered with a porous nylon material, which enhances the ability of the balloon to obtain traction on slippery tissue surfaces. The surgeon inserts the deflated, retracted Soft-Wand™ through a trocar and into the abdomen, extends the balloon by sliding the shaft through the sheath, and then inflates the balloon with 20 cc of air using a syringe. The inflated balloon provides a surface ~4 cm in breadth for the purpose of retracting intestines or other tissue/organs, which is an improvement over the retracting ability of a cylindrical rod 10 mm in diameter (i.e., a typical laparoscopic instrument). The design of the Soft-Wand™ can be improved upon, though, as will be described in the following sections.

III. STATEMENT OF NEED

During minimally invasive (i.e., laparoscopic) procedures on the abdomen, a device is needed to retract loops of intestine. An ideal intestinal retractor would have a broad “footprint” which could control multiple loops of bowel, much in the way a human hand does during an open procedure. The 4 cm breadth that the Soft-Wand™ provides often is inadequate for intestinal retraction. The surface of the ideal retractor should have a relatively nonslip surface, yet the retractor would be atraumatic to the tissue. Such a retractor would need to fit through a 12 mm trocar, be simple to operate, and be relatively cheap.

IV. OVERVIEW OF THE PROPOSED DEVICE

The proposed device (Figures 4-5) is modeled on a commercially-available balloon retractor, the Soft-Wand™ (Figures 1-3), manufactured by Gyrus ACMI (Southborough, MA; www.gyrusacmi.com). The proposed device is inserted into the abdomen through a trocar, and the triple-headed balloon is inflated. This produces a soft, triangular-shaped nonslip retracting surface about 10 cm in breadth (compared to 4 cm with the Soft-Wand™). The generic name given to the proposed device is the “wide-span balloon retractor,” to distinguish it from the conventional balloon retractor (i.e., Soft-Wand™) shown in Figures 1-3. A possible proprietary name for the proposed device is “Laprotract” which, per a Googol-based search on April 16, 2008, does not appear to be in use. Given the simple technology, the projected cost per unit (single use per unit) for the wide-span balloon retractor should not be much more than that for the Soft-Wand™, which is ~\$120 per unit.

V. UTILITY OF THE PROPOSED DEVICE

The proposed device (the wide-span balloon retractor) would be used in minimally invasive (laparoscopic) abdominal procedures which require intestinal retraction. As such, the potential frequency of use would be high. The wide-span balloon retractor would not be limited to intestinal retraction or to use within the abdomen, however; any minimally invasive procedure which requires retraction of a large organ (e.g., liver, spleen, lung, heart) would be ideal for the wide-span balloon retractor.

VI. DETAILED DESCRIPTION OF THE PROPOSED DEVICE

(Refer to Figure 4) The wide-span balloon retractor consists of a cylindrical metal shaft (2) about 40 cm in length and <10 mm in diameter (Figure 4A). The shaft (2) is housed within a plastic sheath (3), which is <12 mm in diameter. The sheath (3) fits through a 12 mm trocar. A plastic flange (4) is mounted on the upper end of the sheath (2). The flange (4) functions as a backstop so that the sheath (2) cannot be over-advanced into trocar (the flange on the Soft-Wand™ in Figures 1-3 has a similar function). In the retracted configuration (Figure 4A), the device may be slid in and out of a 12 mm trocar. At the external (i.e., outside the abdomen) end of the device is a connector of the universal Luer-Lok™ type, onto which a 30 cc syringe (5) is temporarily connected. After the device has been inserted into the abdomen in the retracted position (Figure 4A), the shaft (2) is advanced through the sheath (3), as shown by the arrow (6), so that tip of the shaft (2) is well beyond the end of the sheath (3). At this point air is forcefully injected into the triple-headed balloon (1) with the 30 cc syringe (5), and the balloon (5) assumes its expanded configuration (Figure 4B). The syringe (5) then is removed from the end of the shaft (2), and the device can be used to retract the viscera. The Luer-Lok™ connection at the external end of the shaft (2) contains a pressure-actuated valve (similar to the Soft-Wand™) so that spontaneous loss of air will not occur when the 30 cc syringe (5) is disconnected from the shaft (2). In order to remove the device from within the abdomen, the 30 cc syringe (5) is connected back to the shaft (2), the air is aspirated out of the triple-headed balloon (1), the deflated balloons are withdrawn back into the sheath (3) by pulling the shaft (2) out, and the device then may be withdrawn out of the trocar. The device may be repeatedly inserted, inflated, deflated, and withdrawn as often as the surgeon requires, similar to the Soft-Wand™.

(Refer to Figure 5) The sheath (1) of the wide-span balloon retractor is shown in Figure 5A with the triple-headed balloon retracted inside the sheath (1). In Figure 5B, the triple-headed balloon (3) is shown extended and inflated. This top view demonstrates the webbing (4) which exists between each head of the triple-headed balloon (3). The webbing (4) ensures that loops of bowel or other tissue will not escape between the balloon heads. Each balloon head (3) is supported by a metal rib (2), or spine, which maintains the slight curvature configured into the inflated balloon heads (3), and enables the triple-headed balloon to transmit the forces that the surgeon applies through the device's shaft in order to retract the intestines. The span of the triple-headed balloon (3) may be as wide as 10 cm. In Figure 5C, a side view of the extended, inflated triple-headed balloon is shown. The ribs maintain a gentle inferior curvature, analogous to the way fingers would curl during manual manipulation of the viscera. An end-on view of the extended, inflated triple-headed balloon is shown in Figure 5D. The balloon heads (3) are shown supported by the metal ribs (2) and connected with the webbing (4). The balloons themselves are covered with a nonproprietary mesh material (similar to nylon stockings) to form a relatively nonslip surface.

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VII. FIGURE LEGENDS

Figure 1. Images of the Soft-Wand™ Balloon Retractor, as manufactured by Gyrus ACMI.

Images taken from the manufacturer's web site.

(A) Soft-Wand™ extended with the balloon inflated.

(B) Soft-Wand™ retracted with the balloon deflated.

(C) Intraoperative image of the Soft-Wand™ lifting a lobe of liver.

- 1) Balloon (inflated)
- 2) Sheath
- 3) Flange
- 4) Shaft
- 5) Syringe for balloon inflation

Figure 2. More images of Soft-Wand™ retractor, downloaded from a vendor's web site.

- 1) Balloon (inflated)
- 2) Sheath
- 3) Flange
- 4) Shaft

Figure 3. Close-up images of the Soft-Wand™ retractor, taken from one of the author's previous publications (Carlson et al., *J Laparoendosc Surg* 6:349-351). Balloon dimensions as shown.

Figure 4. Full view of the Wide-Span Balloon Retractor, with dimensions. The lower end of the instrument which is inserted into the abdominal cavity is to the left of the Figure. The upper end of the instrument which remains outside the patient is to the right of the Figure.

- (A) Triple-headed balloon deflated and retracted into the sheath.
- (B) Triple-headed balloon inflated and extended from the sheath.
 - 1) Triple-headed balloon (inflated)
 - 2) Shaft
 - 3) Sheath
 - 4) Flange
 - 5) Syringe for balloon inflation
 - 6) Arrow indicating direction of extension

Figure 5. Close-up views of the Wide-Span Balloon Retractor, with dimensions.

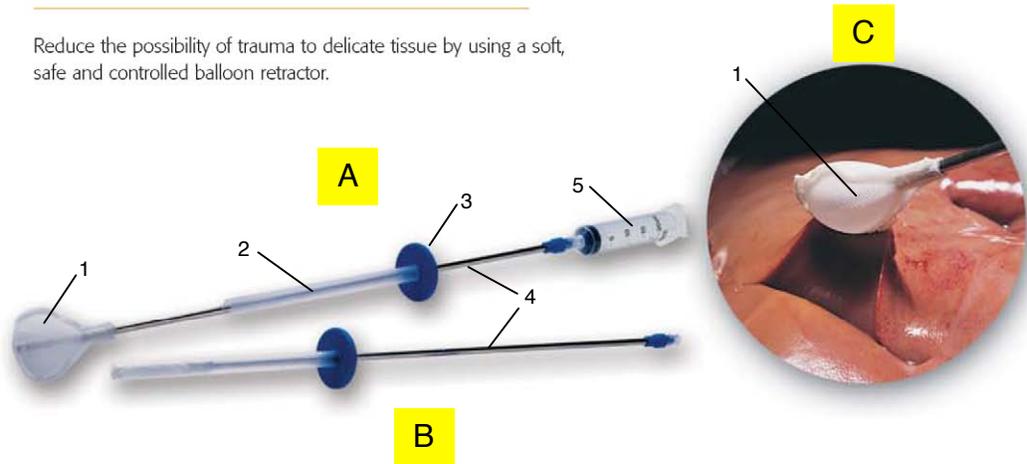
- (A) Retractor sheath with triple-headed balloon (not visible) deflated and retracted.
- (B) Triple-headed balloon inflated and extended from the sheath (top view).
- (C) Triple-headed balloon inflated and extended from the sheath (side view).
- (D) Triple-headed balloon inflated and extended from the sheath (end view).
 - 1) Sheath
 - 2) Metal rib for balloon support
 - 3) Lateral head of the triple-headed balloon
 - 4) Webbing between balloons

REDUCE TISSUE TRAUMA

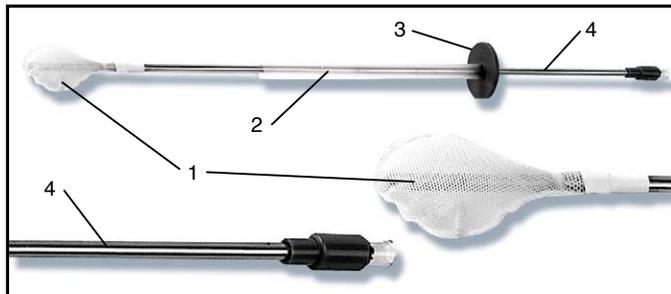
SOFT-WAND™ BALLOON RETRACTOR

Reduce the possibility of trauma to delicate tissue by using a soft, safe and controlled balloon retractor.

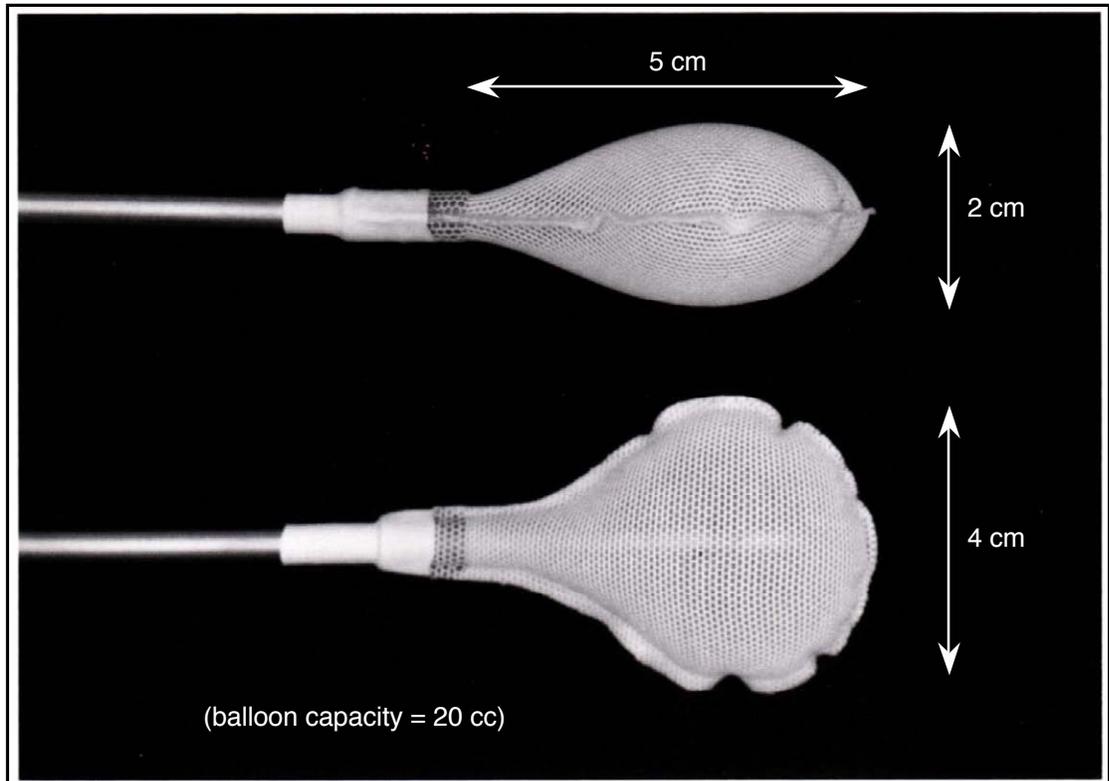
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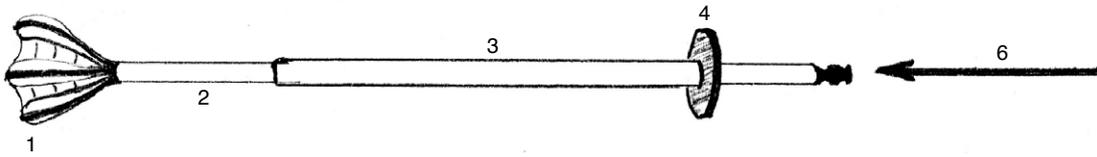
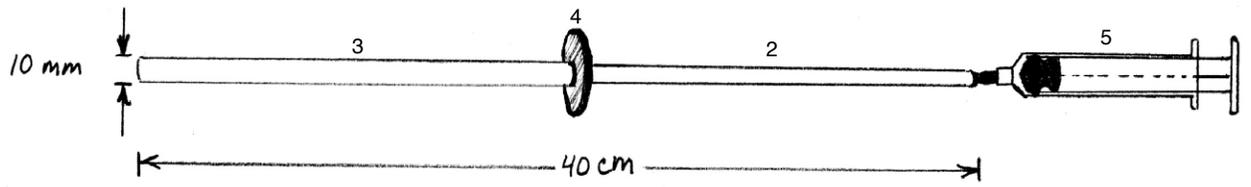


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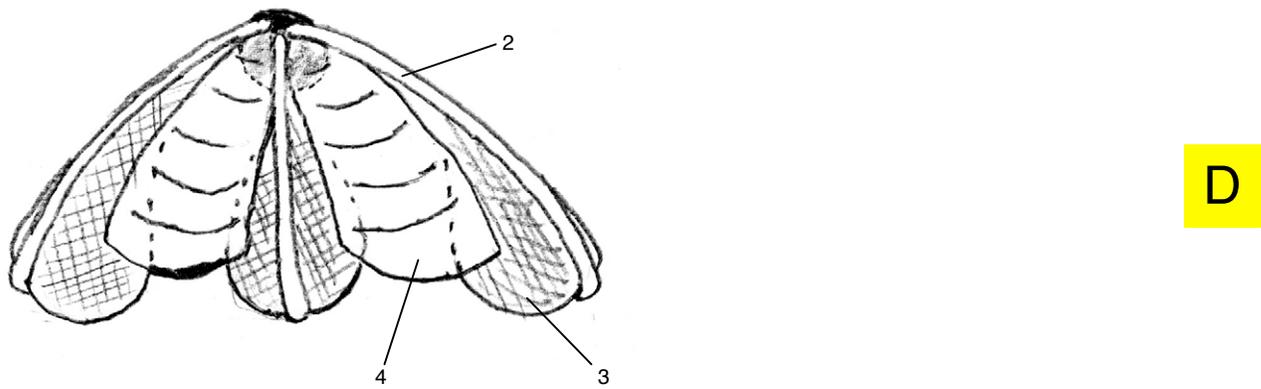
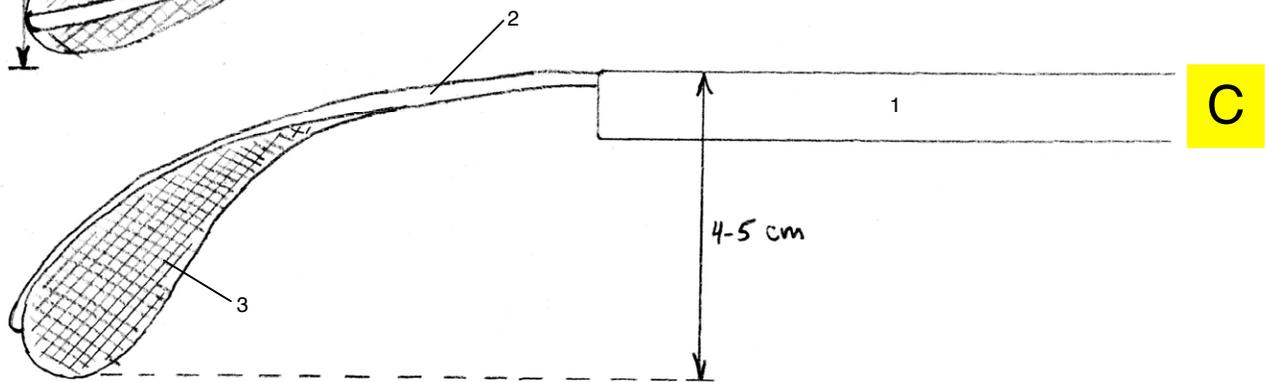
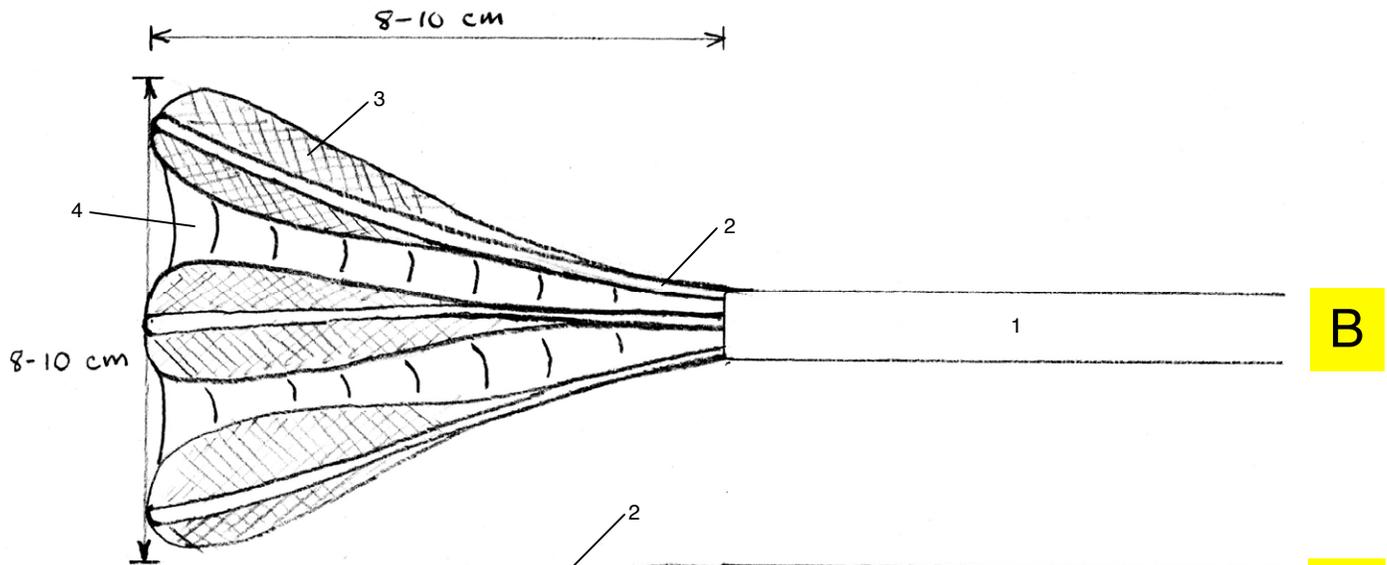
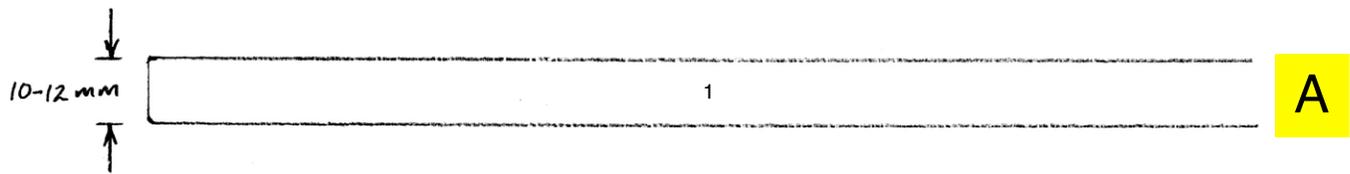
Carlson/Wide Span Balloon Retractor
Figures 1-3

A



B

Carlson/Wide Span Balloon Retractor
Figure 4



Carlson/Wide Span Balloon Retractor
Figure 5