[0006] However, microanastomosis of arteries is most often accomplished with standard manual suturing techniques because the thick, muscular wall of the arteries precludes use of the current microanastomotic couplers. The thick wall of the artery prevents the tissue of the arterial wall from being stretched over the rings of a coupler. Each microanastomotic coupler ring has a plurality of pins or posts, which are used to secure an everted portion of a vessel segment to the ring. Even after securing one portion of an everted arterial segment to a pin or post (or even a few pins or posts) of a microanastomotic coupler ring, efforts to secure remaining portions of the everted arterial segment to the coupler ring are often complicated by the first portion coming off the previously-secured pin(s) or post(s). Due to the lack of a reliable device or technique to avoid this problem, manual suturing is predominantly used for surgical coaptation of arteries.

[0007] Microscopic manual suturing of arteries can be quite challenging, primarily due to the small size of the vessels and the minimal working space. Since most vessels are only 1 to 3 mm in diameter, the procedure requires the use of a surgical microscope. The sutures are about 70 μm thick and can be difficult to handle. As a result, surgeons and surgical residents must undergo extensive additional training prior to operating on a patient in need of tissue transfer. Moreover, surgeons attempt to limit the recipient site morbidity resulting in small incisions and small areas within which to work. For instance, in microsurgical postmastectomy breast reconstruction, the surgeon will typically be working in a 2.5 to 3 cm surgical field. These size constraints make it difficult for surgeons to maneuver their surgical instruments. Arterial microanastomoses performed by manual suturing take approximately 23.5 minutes in the operating room, versus coaptation times as low as 5 minutes or less that would be possible if a surgeon were using a coupling device.

SUMMARY OF THE DISCLOSURE

[0007a]According to a first aspect of the present invention, there is provided an everter device comprising: an everting member having an everter end; an inflation shaft extending distally of the everter end; and an intralumenal catheter balloon in fluid communication with the inflation shaft, wherein the everter end has a curved surface with one or more openings thereon to accommodate posts or pins of a coupler ring of a microanastomosis clamp system.

[0007b]According to a second aspect of the present invention, there is provided an everter device comprising: an everting member having an everter end; and a plunger telescopically-mounted in the everting member and having a distal end that extends distally of the everter end, wherein the everter end has a curved surface with one or more openings thereon to accommodate posts or pins of a coupler ring of a microanastomosis clamp system.

[0007c]According to a third aspect of the present invention, there is provided an everter device comprising: an everting member having an everter end; and a shaft projecting distally of the everter end, the shaft including a radially expanding member that is selectably expandable from a first diameter to a second diameter larger than a nominal diameter of the shaft, wherein the everter end has a curved surface with one or more openings thereon to accommodate posts or pins of a coupler ring of a microanastomosis clamp system.

[0007d]According to a fourth aspect of the present invention, there is provided an everter device comprising: an elongate main body; and an eversion surface at a first end of the elongate main body, the eversion surface comprising a curved surface with one or more openings that have materials that are formed of a pierceable material permitting penetration by coupler pins when everting a portion of a vessel.

[0008] Various embodiments of devices are disclosed herein that make arterial microanastomosis easier and more time-efficient by eliminating the need for sutures and enabling the use of the microanastomotic coupler. Simplifying the arterial microanastomotic procedure minimizes required exercise of operator skill, reduces the duration of intense concentration, and helps reduce the surgeon's fatigue during long, complex operative procedures. In each of the disclosed embodiments, a device provides a mechanism for delivering a uniform or substantially uniform intraluminal force behind or within a coupling ring of a

CLAIMS

What is claimed is:

1. An everter device comprising:

an everting member having an everter end;

an inflation shaft extending distally of the everter end; and

an intralumenal catheter balloon in fluid communication with the inflation shaft,

wherein the everter end has a curved surface with one or more openings thereon to accommodate posts or pins of a coupler ring of a microanastomosis clamp system.

2. The everter device of claim 1, the one or more openings including a circumferential slot.

3. The everter device of claim 1 or 2, at least one of the one or more openings having a material therein that is pierceable, deformable, or axially recedes, when the everter device is advanced into contact with posts or pins of a coupler ring.

4. An everter device comprising:

an everting member having an everter end; and

a plunger telescopically-mounted in the everting member and having a distal end that extends distally of the everter end,

wherein the everter end has a curved surface with one or more openings thereon to accommodate posts or pins of a coupler ring of a microanastomosis clamp system.

5. The everter device of claim 4, at least one of the one or more openings having a material therein that is pierceable, deformable, or axially recedes, when the everter device is advanced into contact with posts or pins of a coupler ring.

6. An everter device comprising:

an everting member having an everter end; and

a shaft projecting distally of the everter end, the shaft including

a radially expanding member that is selectably expandable from a first diameter to a second diameter larger than a nominal diameter of the shaft,

wherein the everter end has a curved surface with one or more openings thereon to accommodate posts or pins of a coupler ring of a microanastomosis clamp system.

7. The everter device of claim 6, wherein the shaft includes

an outer shaft;

an inner shaft disposed within and slidable axially relative to the outer shaft;

an end cap secured to a distal end of the inner shaft; and wherein the radially expanding member is disposed about the inner shaft between a proximal end of the end cap and a distal end of the outer shaft.

8. The everter device of claim 6, the radially expanding member made of at least one of a flexible material or a rigid material.

9. The everter device of claim 8, the radially expanding member made of a flexible material selected from the group of a thermoplastic elastomer and a silicone rubber.

10. The everter device of claim 8, the radially expanding member made of a rigid material selected from the group of a thermoplastic and a stainless steel.

11. An everter device comprising:

an elongate main body; and

an eversion surface at a first end of the elongate main body, the eversion surface comprising a curved surface with one or more openings that have materials that are formed of a pierceable material permitting penetration by coupler pins when everting a portion of a vessel.

12. The everter device of claim 11, the pierceable material including a medical grade silicone having a Shore A hardness in a range of 10-50.

13. The everter device of claim 11, wherein the elongate main body is at least substantially formed of the pierceable material.

14. The everter device of claim 13, further comprising a supporting rod that serves to maintain structural rigidity of the everter device.

15. The everter device of claim 14, wherein the supporting rod is deformable by a user of the everter device.

16. The everter device of claim 11, further comprising a second eversion surface at a second end of the eversion device opposite the eversion surface at the first end of the everter device.

17. The everter device of claim 16, the second eversion surface having at least one of a different size or contour than the eversion surface at the first end of the everter device.