

CLAIMS

We claim:

1. A valve repair device for repairing a native valve of a patient, the valve repair device comprising:
 - a coaption element formed from a solid or hollow piece of molded material;
 - an anchor portion having a plurality of anchors that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient and hold leaflets of the native valve against the coaption element.
2. The valve repair device of claim 1, wherein the coaption element is formed by injection molding.
3. The valve repair device of any one of claims 1-2, further comprising:
 - a main shaft extending from the anchor portion;
 - wherein the coaption element is removably attached to the main shaft.
4. The valve repair device of claim 3, wherein the coaption element attaches to the main shaft with a quarter-turn connection.
5. The valve repair device of any one of claim 1-4, wherein the coaption element is formed from solid or foamed plastic.
6. The valve repair device of any one of claims 1-5, wherein the coaption element comprises a body portion and a plurality of wing portions.
7. The valve repair device of claim 6, wherein the wing portions are separated by tapered grooves.
8. A valve repair device for repairing a native valve of a patient, the valve repair device comprising:
 - a main shaft;
 - an attachment projection extending outward from the main shaft;
 - a coaption portion comprising:

a central opening for receiving the main shaft;

a groove along the central opening that allows the attachment projection to pass through the coaption portion;

at least one engagement recess for receiving the attachment projection of the main shaft;

an actuation shaft extending through the main shaft;

a cap attached to the actuation shaft such that the cap can be moved by the actuation shaft away from the main shaft;

a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient; and

at least one clasp attached to each of the paddle portions;

wherein movement of the cap toward the main shaft causes the paddle portions to move to the closed position, and movement of the cap away from the main shaft causes the paddle portions to move to the open position.

9. The valve repair device of claim 8, wherein the coaption element is formed from a solid or hollow piece of molded material.
10. The valve repair device of any one of claims 8-9, wherein the coaption element is formed by injection molding.
11. The valve repair device of any one of claims 8-10, wherein the groove and the at least one engagement recess are arranged about 90 degrees apart around the central opening of the coaption portion.
12. A valve repair device for repairing a native valve of a patient, the valve repair device comprising:
 - a main shaft having a plurality of paddle openings;
 - an attachment projection extending outward from the main shaft;
 - a coaption portion;
 - an actuation shaft extending through the main shaft;

a cap attached to the actuation shaft such that the cap can be moved by the actuation shaft away from the main shaft, the cap including a plurality of paddle openings; and

a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient, wherein a proximal end of each paddle is inserted into one of the plurality of paddle openings in the main shaft and a distal end of each paddle is inserted into one of the plurality of paddle openings in the cap;

wherein movement of the cap toward the main shaft causes the paddle portions to move to the closed position, and movement of the cap away from the main shaft causes the paddle portions to move to the open position.

13. The valve repair device of claim 12, wherein the coaption element is formed from a solid or hollow piece of molded material.
14. The valve repair device of any one of claims 12-13, wherein the coaption element is formed by injection molding.
15. The valve repair device of any one of claims 12-14, wherein the proximal and distal ends of the paddles include attachment portions that snap into the main shaft paddle portion and the cap paddle portion, respectively.
16. The valve repair device of any one of claims 12-15, wherein the proximal and distal ends of the paddles include attachment portions that are squeezed together before insertion into their respective paddle openings.
17. A valve repair device for repairing a native valve of a patient, the valve repair device comprising:

a main shaft;

an attachment projection extending outward from the main shaft;

a coaption portion;

an actuation shaft extending through the main shaft;

a cam portion attached to the actuation shaft, the cam portion rotatable between an engaged position and a disengaged position;

a cap attached to the cam portion such that the cap can be moved by the actuation shaft away from the main shaft; and

a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient;

wherein when the cam portion is in the engaged position movement of the cam portion toward the main shaft causes the cam portion to engage the paddles to spread the paddles apart;

wherein movement of the cap toward the main shaft causes the paddle portions to move to the closed position, and movement of the cap away from the main shaft causes the paddle portions to move to the open position.

18. The valve repair device of claim 17, wherein the cam portion is rotated about 90 degrees by the actuation shaft to transition from the stowed condition to the deployed condition.
19. The valve repair device of any one of claims 17-18, wherein the cam portion is disposed within a portion of the main shaft when the cam portion is in the stowed condition.
20. The valve repair device of any one of claims 17-19, wherein the cam portion engages a flexible portion of the paddles.
21. A valve repair device for repairing a native valve of a patient, the valve repair device comprising:

a coaption element including a plurality of cutouts that allow the coaption element to be compressed to fit within a delivery catheter;

an anchor portion having a plurality of anchors that are configured to attach to the coaption element in a native valve of the patient.
22. The valve repair device of claim 21, wherein the coaption element comprises a flexible material.
23. The valve repair device of any one of claims 21-22, further comprising:

a main shaft extending from the anchor portion;

wherein the coaption element is removably attached to the main shaft.

24. The valve repair device of any one of claims 21-23, wherein the coaption element comprises a body portion and one or more arm portions.
25. The valve repair device of claim 24, wherein the one or more arm portions are compressible toward the body portion.
26. The valve repair device of any one of claims 21-25, wherein the coaption element comprises a body portion and a plurality of wing portions.
27. The valve repair device of claim 26, wherein the wing portions are configured to fit in openings in another wing portion.
28. The valve repair device of claim 26, wherein the wing portions are separated by tapered grooves.
29. The valve repair device of claim 28, wherein the tapered grooves are oriented longitudinally and extend radially inward.
30. The valve repair device of claim 28, wherein the tapered grooves are oriented toward a center of the body portion.
31. The valve repair device of claim 28, wherein the tapered grooves are oriented toward a proximal end of the body portion.
32. The valve repair device of claim 26, wherein the plurality of wing portions are compressible toward the body portion via a medially inward force.
33. The valve repair device of claim 26, wherein one or more of the plurality of wing portions are compressible toward a proximal end of the body portion and one or more of the plurality of wing portions are compressible toward a distal end of the body portion.
34. The valve repair device of claim 26, wherein the plurality of wing portions are compressible toward a distal end of the body portion.
35. A valve repair device for repairing a native valve of a patient, the valve repair device comprising:
 - a main shaft having a plurality of paddle openings;
 - an attachment projection extending outward from the main shaft;

a coaption portion that includes a plurality of cutouts that allow the coaption portion to be compressed into a delivery catheter;

an actuation shaft extending through the main shaft;

a cap attached to the actuation shaft such that the cap can be moved by the actuation shaft away from the main shaft, the cap including a plurality of paddle openings; and

a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient.

36. The valve repair device of claim 35, wherein the coaption element is formed from compressible material.

37. The valve repair device of any one of claims 35-36, wherein the coaption element comprises a plurality of wing portions.

38. A valve repair system for repairing a native valve of a patient, the valve repair system comprising:

a main shaft;

an attachment projection extending outward from the main shaft;

a coaption portion comprising:

a central opening for receiving the main shaft;

a groove along the central opening that allows the attachment projection to pass through the coaption portion;

at least one engagement recess for receiving the attachment projection of the main shaft.

39. The system of claim 38, further comprising an actuation element extending through the main shaft.

40. The system of claim 39, further comprising a cap attached to the actuation element such that the cap can be moved by the actuation element away from the main shaft.

41. The system of any one of claims 39-40, further comprising a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient.
42. The system of claim 41, further comprising at least one clasp attached to each of the plurality of paddle portions.
43. The system of any one of claims 41-42, wherein movement of a cap toward the main shaft causes the paddle portions to move to the closed position, and movement of the cap away from the main shaft causes the paddle portions to move to the open position.
44. The system of any one of claims 38-43, wherein the coaption element is formed from a solid or hollow piece of molded material.
45. The system of any one of claims 38-44, wherein the coaption element is formed by injection molding.
46. The system of any one of claims 38-45, wherein the coaption element comprises a body portion and a plurality of wing portions.
47. The system of claim 46, wherein the wing portions are separated by tapered grooves.
48. The system of any one of claims 38-47, wherein the groove and the at least one engagement recess are arranged about 90 degrees apart around the central opening of the coaption portion.
49. A system for repairing a native valve of a patient, the system comprising:
 - a main shaft having a plurality of paddle openings;
 - an attachment projection extending outward from the main shaft;
 - a coaption portion;
 - an actuation shaft extending through the main shaft;
 - a cap attached to the actuation shaft such that the cap can be moved by the actuation shaft away from the main shaft, the cap including a plurality of paddle openings.
50. The system of claim 49, further comprising a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native

valve of the patient, wherein a proximal end of each paddle is inserted into one of the plurality of paddle openings in the main shaft and a distal end of each paddle is inserted into one of the plurality of paddle openings in the cap.

51. The system of claim 50, wherein movement of the cap toward the main shaft causes the paddle portions to move to the closed position, and movement of the cap away from the main shaft causes the paddle portions to move to the open position.
52. The system of any one of claims 49-51, wherein the coaption element is formed from a solid or hollow piece of molded material.
53. The system of any one of claims 49-52, wherein the coaption element is formed by injection molding.
54. The system of any one of claims 49-53, wherein the coaption element comprises a body portion and a plurality of wing portions.
55. The system of claim 54, wherein the wing portions are separated by tapered grooves.
56. The system of any one of claims 49-55, wherein the proximal and distal ends of the paddles include attachment portions that snap into the main shaft paddle portion and the cap paddle portion, respectively.
57. The system of any one of claims 49-56, wherein the proximal and distal ends of the paddles include attachment portions that are squeezed together before insertion into their respective paddle openings.
58. A system for repairing a native valve of a patient, the system comprising:
 - a main shaft;
 - an attachment projection extending outward from the main shaft;
 - a coaption portion;
 - an actuation shaft extending through the main shaft;
 - a cam portion attached to the actuation shaft, the cam portion rotatable between an engaged position and a disengaged position;

a plurality of paddle portions that are moveable between an open position and a closed position and are configured to attach to the native valve of the patient;

wherein when the cam portion is in the engaged position movement of the cam portion toward the main shaft causes the cam portion to engage the paddles to spread the paddles apart;

59. The system of claim 58, further comprising a cap attached to the cam portion such that the cap can be moved by the actuation shaft away from the main shaft.
60. The system of claim 59, wherein movement of the cap toward the main shaft causes the paddle portions to move to the closed position, and movement of the cap away from the main shaft causes the paddle portions to move to the open position.
61. The system of any one of claims 58-60, wherein the cam portion is rotated about 90 degrees by the actuation shaft to transition from the stowed condition to the deployed condition.
62. The system of any one of claims 58-61, wherein the cam portion is disposed within a portion of the main shaft when the cam portion is in the stowed condition.
63. The system of any one of claims 58-62, wherein the cam portion engages a flexible portion of the paddles.
64. The system of any one of claims 58-63, wherein the coaption element is formed from a solid or hollow piece of molded material.
65. The system of any one of claims 58-64, wherein the coaption element comprises a body portion and a plurality of wing portions.
66. The system of claim 65, wherein the wing portions are separated by tapered grooves.