

FLEXIBLE COMMISSURE FRAME

FIELD

[0001] This disclosure is in the field of prosthetic heart valves, stents for use with prosthetic heart valves, and methods for delivering prosthetic heart valves.

BACKGROUND

[0002] Existing frames for prosthetic heart valves typically comprise rows of angled struts and a plurality of axial frame members spaced apart around the circumference of the frame. The plurality of axial frame members may comprise a plurality of leaflet attachment members (for attaching to the commissures of the supported valvular structure) and a multitude of axially directed struts extending between the rows of angled struts. A frame usually has three or more axially directed struts for every leaflet attachment member, and generally has no more than two angled struts located in between adjacent struts or other axial frame members. Indeed, having a large number of axially directed struts is perceived to be necessary for preserving the structural stability of the stent and/or valve. Unfortunately, having a large number of axial struts can come at the expense of valve flexibility.

[0003] A need therefore exists for stents and prosthetic valves that can have a high degree of flexibility, without compromising mechanical integrity or function.

SUMMARY

[0004] In one aspect of the disclosure, a prosthetic device for implantation at a cardiac valve annulus has an annular frame with an inflow end, an outflow end, at least four circumferentially extending rows of angled struts, and a plurality of axial frame members bridging two of the circumferentially extending rows of angled struts that are closest to the outflow end, wherein each axial frame member has a first end closer to the inflow end and a second end closer to the outflow end, and the plurality of axial frame members comprises a plurality of axially extending leaflet attachment members and a plurality of axial struts in a 1:1 ratio, and further wherein there is exactly one row of angled struts linking the second ends of the axial frame members and no more than one row of angled struts between the second ends of the plurality of axial frame members and the outflow end and there are at least three rows of angled struts between the first ends of the plurality of axial frame members and the inflow end.

[0005] In some embodiments, the device can further comprise a leaflet structure positioned within the frame, the leaflet structure having a plurality of commissures that are secured to the frame at the leaflet attachment members.

[0006] In some embodiments, at least three angled struts separate adjacent axial frame members along each of the two rows of angled struts.

[0007] In some embodiments, exactly six angled struts separate adjacent leaflet attachment members along each of the two rows of angled struts, and exactly three angled struts separate adjacent axial frame members along each of the two rows of angled struts, such that each axial strut is positioned halfway between adjacent leaflet attachment members.

[0008] In some embodiments, each axial frame member extends between locations defined by the convergence of adjacent angled struts.

[0009] In some embodiments, the device further comprises an inner skirt secured to an interior portion of the annular frame, and an outer skirt secured to an exterior portion of the annular frame.

[0010] In some embodiments, the frame comprises exactly four rows of angled struts.

[0011] In some embodiments, the valve member comprises exactly three leaflets arranged in a tricuspid configuration, wherein the frame comprises exactly three axial struts and exactly three leaflet attachment members, and wherein the exactly three angled struts separate adjacent axial frame members along each of the two rows of angled struts.

[0012] In another aspect of the disclosure, an annular frame for a prosthetic heart valve can comprise an inflow end, an outflow end, at least four circumferentially extending rows of angled struts, and a plurality of axial frame members spaced angularly around the circumference of the frame. The plurality of axial frame members can bridge two of the circumferentially extending rows of angled struts that are closest to the outflow end, and wherein each of the two rows comprise at least three angled struts between adjacent axial frame members, and further wherein each axial frame member has a first end closer to the inflow end and a second end closer to the outflow end, and there is exactly one row of angled struts linking the second ends of the axial frame members and no more than one row of angled struts between the second ends of the plurality of axial frame members and the outflow end, and there are at least three rows of angled struts between the first ends of the plurality of axial frame members and the inflow end.

[0013] In some embodiments, each of the two rows comprises exactly three angled struts between adjacent axial frame members.

[0014] In some embodiments, the plurality of axial frame members comprises a plurality of axially extending leaflet attachment members, and each of the two rows comprises exactly six angled struts between adjacent leaflet attachment members.

[0022] In another aspect of the disclosure, a prosthetic device for implantation at a cardiac valve annulus is provided, comprising an annular frame having an inflow end, an outflow end, at least four rows of circumferentially extending angled struts, and exactly six axial frame members bridging two rows of the four rows of circumferentially extending angled struts. The plurality of axial frame members can comprise exactly three axially extending leaflet attachment members and exactly three axial struts, wherein each axial frame member has a first end closer to the inflow end and a second end closer to the outflow end, and there is exactly one row of angled struts linking the second ends of the six axial frame members and no more than one row of angled struts between the second ends of the six axial frame members and the outflow end, and there are at least three rows of angled struts between the first ends of the six axial frame members and the inflow end, wherein each of the two rows bridged by the six axial frame members comprises exactly three angled struts between each adjacent pair of a leaflet attachment member and an adjacent axial strut, and exactly six angled struts between adjacent leaflet attachment members. The device can further comprise a tri-leaflet valve member positioned within the frame having commissures that are secured to the frame at the leaflet attachment members, wherein the commissures are secured to the leaflet attachment members adjacent to the outflow end of the frame.

[0023] The foregoing and other objects, features, and advantages of the invention will become more apparent from the following detailed description, which proceeds with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIGS. 1 and 2 show side and perspective views of an exemplary embodiment of a prosthetic heart valve.

[0025] FIGS. 3–5 show side, perspective, and flattened views of an exemplary frame of the prosthetic heart valve of FIG. 1.

[0026] FIG. 6 is a perspective view of another exemplary prosthetic heart valve.

[0027] FIGS. 7–8 show perspective and flattened views of an exemplary frame of the prosthetic heart valve of FIG. 6.

[0028] FIG. 9 shows a flattened view of another exemplary frame for a prosthetic heart valve.

[0029] FIG. 10 shows a flattened view of a portion of another exemplary frame for a prosthetic heart valve.

WE CLAIM:

1. A prosthetic device for implantation at a cardiac valve annulus, the prosthetic device comprising:

an annular frame having an inflow end, an outflow end, at least four circumferentially extending rows of angled struts, and a plurality of axial frame members bridging two of the circumferentially extending rows of angled struts that are closest to the outflow end, wherein each axial frame member has a first end closer to the inflow end and a second end closer to the outflow end, and the plurality of axial frame members comprises a plurality of axially extending leaflet attachment members and a plurality of axial struts in a 1:1 ratio, and further wherein there is exactly one row of angled struts linking the second ends of the axial frame members and no more than one row of angled struts between the second ends of the plurality of axial frame members and the outflow end, and there are at least three rows of angled struts between the first ends of the plurality of axial frame members and the inflow end.

2. The device of claim 1, further comprising a leaflet structure positioned within the frame having a plurality of commissures that are secured to the frame at the leaflet attachment members, wherein the commissures are secured to the leaflet attachment members adjacent to the outflow end of the frame.

3. The device of claim 1, wherein at least three angled struts separate adjacent axial frame members along each of the two rows of angled struts that are closest to the outflow end.

4. The device of claim 1, wherein exactly six angled struts separate adjacent leaflet attachment members along each of the two rows that are closest to the outflow end and exactly three angled struts separate adjacent axial frame members along each of the two rows that are closest to the outflow end, such that each axial strut is halfway between adjacent leaflet attachment members.

5. The device of claim 1, wherein each axial frame member extends between locations defined by a convergence of adjacent angled struts.

6. The device of claim 1, further comprising an inner skirt secured to an interior portion of the annular frame, and an outer skirt secured to an exterior portion of the annular frame.

7. The device of claim 1, wherein the frame comprises exactly four rows of angled struts.

8. The device of claim 2, wherein the leaflet structure comprises exactly three leaflets arranged in a tricuspid configuration, wherein the frame comprises exactly three axial struts and exactly three leaflet attachment members, and wherein exactly three angled struts separate adjacent axial frame members along each of the two rows of angled struts.

9. An annular frame for a prosthetic heart valve, the annular frame comprising:
an inflow end, an outflow end, at least four circumferentially extending rows of angled struts, and a plurality of axial frame members spaced angularly around the circumference of the frame, wherein the plurality of axial frame members bridge two of the circumferentially extending rows of angled struts that are closest to the outflow end, and wherein each of the two rows comprise at least three angled struts between adjacent axial frame members, and further wherein each axial frame member has a first end closer to the inflow end and a second end closer to the outflow end, and there is exactly one row of angled struts linking the second ends of the axial frame members and no more than one row of angled struts between the second ends of the plurality of axial frame members and the outflow end, and there are at least three rows of angled struts between the first ends of the plurality of axial frame members and the inflow end.

10. The frame of claim 9, and wherein each of the two rows that are closest to the outflow end comprises exactly three angled struts between adjacent axial frame members.

11. The frame of claim 10, wherein the plurality of axial frame members comprises a plurality of axially extending leaflet attachment members, and wherein each of the two rows that are closest to the outflow end comprise exactly six angled struts between adjacent leaflet attachment members.

12. The frame of claim 9, wherein the plurality of axial frame members comprises a plurality of axially extending leaflet attachment members and a plurality of axial struts, and wherein each of the two rows that are closest to the outflow end comprises four angled struts between adjacent axial struts and eight angled struts between adjacent leaflet attachment members.

13. The frame of claim 9, wherein the plurality of axial frame members comprises a plurality of leaflet attachment members and a plurality of axial struts in a 1:1 ratio.

14. The frame of claim 13, wherein the plurality of axial frame members comprises exactly three leaflet attachment members and exactly three axial struts.

15. The frame of claim 11, wherein the leaflet attachment members extend between locations defined by a convergence of upper ends of adjacent angled struts, and the axial struts extend between locations defined by a convergence of lower ends of adjacent angled struts.

16. The frame of claim 9, wherein:

the plurality of axial frame members comprises a plurality of axially extending leaflet attachment members and a plurality of axial struts;

the two rows of angled struts that are closest to the outflow end comprise a first row and a second row, wherein the first row is closer to the outflow end than the second row;

the leaflet attachment members extend from locations defined by the convergence of the upper ends of adjacent angled struts along the first row to locations defined by the convergence of the lower ends of adjacent angled struts along the second row; and

the axial struts extend between locations defined by the convergence of the lower ends of adjacent angled struts along the first row to locations defined by the convergence of upper ends of adjacent angled struts along the second row.

17. The frame of claim 9, wherein the frame comprises exactly four rows of angled struts.

18. A prosthetic device for implantation at a cardiac valve annulus, the prosthetic device comprising:

an annular frame having an inflow end, an outflow end, at least four rows of circumferentially extending angled struts, and exactly six axial frame members bridging two rows of the four rows of circumferentially extending angled struts,

wherein the plurality of axial frame members comprises exactly three axially extending leaflet attachment members and exactly three axial struts;

wherein each axial frame member has a first end closer to the inflow end and a second end closer to the outflow end, and there is exactly one row of angled struts linking the second ends of the six axial frame members and no more than one row of angled struts between the second ends of the six axial frame members and the outflow end, and there are at least three rows of angled struts between the first ends of the six axial frame members and the inflow end;

wherein each of the two rows bridged by the six axial frame members comprises exactly three angled struts between each pair of a leaflet attachment member and an adjacent axial strut and exactly six angled struts between adjacent leaflet attachment members; and

a tri-leaflet valve member positioned within the frame having commissures that are secured to the frame at the leaflet attachment members;

wherein the commissures are secured to the leaflet attachment members adjacent to the outflow end of the frame.

19. The prosthetic device of claim 18, wherein:

the at least four rows comprise a first row and a second row, wherein the first row is closer to the outflow end than the second row,

the leaflet attachment members extend from locations defined by a convergence of upper ends of adjacent angled struts along the first row to locations defined by

a convergence of upper ends of adjacent angled struts along the second row,
and

the axial struts extend between locations defined by a convergence of lower ends of
adjacent angled struts along the first row to locations defined by a convergence
of lower ends of adjacent angled struts along the second row.

20. The prosthetic device of claim 18, wherein the frame comprises exactly four
rows of circumferentially extending angled struts.