A VASCULAR STENT WITH A MIXED CONFIGURATION OF CONNECTORS

BACKGROUND OF THE INVENTION

[0001] ~~This~~Embodiments of the invention provide~~s~~ for a radially expandable stent having superior strength and reduced foreshortening properties. The stents have a mixed configuration of straight and arcuate connector segments that serve to join annular segments that make up the body of the stent. Surprisingly, the described mixed configuration with three links may provide~~s~~ superior resistance to flip deformation and longitudinal compression while maintaining desired flexibility.

BRIEF SUMMARY OF THE INVENTION

[0002] ~~This~~A first aspect of the invention provides for a radially expandable stent for insertion into a body vessel having a tubular body ~~with~~ having a circumference, a distal end and a proximal end~~s~~, the tubular body comprising:

a plurality of annular segments defining a longitudinal axis where each annular segment has a substantially zig-zag shape forming a series of peaks and valleys wherein the plurality of annular segments comprise a distal and a proximal annular end segment respectively defining the distal and proximal ends of the tubular body and at least two annular segments positioned internally between the two end annular segments; and,

a plurality of connector segments positioned parallel to the longitudinal axis and bridging the annular segments where the connector segments between the annular end segments and their adjoining annular internal segments are straight, and are ~~at least~~ three in number, and at least 90% of the connector segments between the internal annular segments are arcuate.

[0003] The stents may further comprise a configuration where the peaks and valleys of the annular segments are 180° out of phase with the annular segment adjacent to it such that the peaks of a first and a third annular segment extend toward a second annular

segment positioned between the first and third segments and are aligned longitudinally with the valleys of the second annular segment. Alternatively, the stents may be configured such that the peaks and valleys of the annular segments are in phase with the annular segment adjacent to it such that the peaks of a first and a third annular segment extend toward a second annular segment positioned between the first and third segments and are aligned longitudinally with the peaks of the second annular segment.

[0004] Further, the stents of this invention may be configured such that the connector segments between the distal annular end segment and the next two internally positioned annular segments are straight.

[0005] It is preferred that the straight connector segments between annular end segments and their adjoining annular internal segments are three in number and they may optionally be positioned equidistant from each other along the circumference of the tubular body.

[0006] It is preferred that the stents described herein have a flip force required to catastrophically deform the stent of greater than 0.2 newtons.

[0007] The stents described herein may be formed of a metal tubular body such as a cobalt chromium alloy.

[0008] The stents described herein may further comprise a drug-eluting coating. The coating may comprise rapamycin or a 40-O derivative of rapamycin.

[0009] ~~In addition, this~~ A second aspect of the invention provides for a method of manufacturing a radially expandable stent for insertion into a body vessel ~~having the above-described configurations and properties.~~ where the stent has a tubular body with a circumference, a distal end and a proximal end, the method comprising: forming the tubular body of the stent to have a plurality of annular segments defining a longitudinal axis where each annular segment has a substantially zig-zag shape forming a series of

peaks and valleys wherein the plurality of annular segments comprise a distal and a proximal annular end segment respectively defining the distal and proximal ends of the tubular body and at least two annular segments positioned internally between the two end annular segments; and, a plurality of connector segments positioned parallel to the longitudinal axis and bridging the annular segments where the connector segments between the end segments and their adjoining internal segments are straight, and are three in number, and at least 90% of the connector segments between the internal annular segments are arcuate.

Clams:

1. A radially expandable stent for insertion into a body vessel having a tubular body having a circumference, a distal end and a proximal end wherein the tubular body comprises:

a plurality of annular segments defining a longitudinal axis where each annular segment has a substantially zig-zag shape forming a series of peaks and valleys wherein the plurality of annular segments comprise a distal and a proximal annular end segment respectively defining the distal and proximal ends of the tubular body and at least two annular segments positioned internally between the two end annular segments; and,

a plurality of connector segments positioned parallel to the longitudinal axis and bridging the annular segments where the connector segments between the annular end segments and their adjoining annular internal segments are straight, and are ~~at least~~ three in number, and at least 90% of the connector segments between the internal annular segments are arcuate.

2. The stent of claim 1 wherein the peaks and valleys of the annular segments are 180° out of phase with the annular segment adjacent to it such that the peaks of a first and a third annular segment extend toward a second annular segment positioned between the first and third segments and are aligned longitudinally with the valleys of the second annular segment.

~~3. The stent of claim 1 wherein the straight connector segments between annular end segments and their adjoining annular internal segments are three.~~

43. The stent of claim 1 wherein the straight connector segments between annular end segments and their adjoining annular internal segments are positioned equidistant from each other along the circumference of the tubular body.

~~5~~4. The stent of claim ~~3~~1 wherein the straight connector segments between annular end segments and their adjoining annular internal segments are positioned equidistant from each other along the circumference of the tubular body.

~~6~~5. The stent of claim 1 wherein the peaks and valleys of the annular segments are in phase with the annular segment adjacent to it such that the peaks of a first and a third annular segment extend toward a second annular segment positioned between the first and third segments and are aligned longitudinally with the peaks of the second annular segment.

~~7~~6. The stent of claim 1 wherein the connector segments between the distal annular end segment and the next two internally positioned annular segments are straight.

~~8~~7. The stent of claim 1 wherein the flip force required to catastrophically deform the stent is greater than 0.2 newtons.

~~9~~8. The stent of claim 1 where the tubular body is a metal.

~~10~~9. The stent of claim 1 where the metal is a cobalt chromium alloy.

~~11~~10. The stent of claim 1 further comprising a drug eluting coating.

~~12~~11. The stent of claim ~~11~~ 10 comprising rapamycin or a 40-O derivative of rapamycin.

~~13~~12. The stent of claim 1 wherein the stent has dimensions for supporting a coronary artery.

~~14~~13. The stent of claim 1 wherein the stent has dimensions for supporting a peripheral artery.

~~15~~14. A method of manufacturing a radially expandable stent for insertion into a body vessel where the stent has a tubular body with a circumference, a distal end and a proximal end, the method comprising:

forming the tubular body of the stent to have a plurality of annular segments defining a longitudinal axis where each annular segment has a substantially zig-zag shape forming a series of peaks and valleys wherein the plurality of annular segments comprise a distal and a proximal annular end segment respectively defining the distal and proximal ends of the tubular body and at least two annular segments positioned internally between the two end annular segments; and,

a plurality of connector segments positioned parallel to the longitudinal axis and bridging the annular segments where the connector segments between the end segments and their adjoining internal segments are straight, and are ~~at least~~ three in number, and at least 90% of the connector segments between the internal annular segments are arcuate.

~~16~~15. The method of claim ~~15~~14 wherein the peaks and valleys of the annular segments are 180° out of phase with the annular segment adjacent to it such that the peaks of a first and a third annular segment extend toward a second annular segment positioned between the first and third segments and are aligned longitudinally with the valleys of the second annular segment.

~~17. The method of claim 15 wherein the straight connector segments between annular end segments and their adjoining annular internal segments are three.~~

~~18~~16. The method of claim ~~15~~14 wherein the straight connector segments between annular end segments and their adjoining annular internal segments are positioned equidistant from each other along the circumference of the tubular body.

~~19~~17. The method of claim ~~15~~14 wherein the straight connector segments between annular end segments and their adjoining annular internal segments are positioned equidistant from each other along the circumference of the tubular body.

~~20~~18. The method of claim ~~15~~14 wherein the peaks and valleys of the annular segments are in phase with the annular segment adjacent to it such that the peaks of a first

and a third annular segment extend toward a second annular segment positioned between the first and third segments and are aligned longitudinally with the peaks of the second annular segment.

~~21~~19. The method of claim ~~15~~14 wherein the connector segments between the distal annular end segment and the next two internally positioned annular segments are straight.

~~22~~20. The method of claim ~~15~~14 wherein the flip force required to catastrophically deform the stent is greater than 0.2 newtons.

~~23~~21. The method of claim ~~15~~14 where the tubular body is a metal.

~~24~~22. The method of claim ~~13~~12 where the metal is a cobalt chromium alloy.

~~25~~23. The method of claim ~~15~~14 further comprising a drug eluting coating.

~~26~~24. The method of claim ~~15~~14 comprising rapamycin or a 40-O derivative of rapamycin.