United States Patent Application Publication	20250262090
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	Sekhavat; Houfar et al.

GLAUCOMA SHUNTS AND RELATED METHODS OF USE

Abstract

Glaucoma shunts comprising an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body are disclosed herein. Also disclosed are methods of decreasing intraocular pressure in an eye, the method comprising inserting at least a portion of a glaucoma shunt into an anterior chamber of the eye, and draining aqueous humour from the anterior chamber through the lumen.

Inventors: **Sekhavat; Houfar (Dieppe, CA), Shoham-Hazon; Nir (Miramichi, CA)**

Applicant: **Hexiris Inc.** (Dieppe, CA)

Family ID: **1000008575134**

Appl. No.: **19/072936**

Filed: **March 06, 2025**

Foreign Application Priority Data

CA	3058571	Oct. 11, 2019

Related U.S. Application Data

parent US continuation 17768184 20220411 parent-grant-document US 12268635 WO continuation PCT/CA2020/051358 20201009 child US 19072936

Publication Classification

Int. Cl.: **A61F9/007** (20060101)

U.S. Cl.:

CPC **A61F9/00781** (20130101); **A61F9/00736** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This is a Continuation of U.S. patent application Ser. No. 17/768,184, a US national phase of international application PCT/CA2020/051358, filed Oct. 9, 2020, which claims priority to Canada patent application 3,058,571, filed Oct. 11, 2019, each of which is hereby incorporated by reference in its entirety.

FIELD OF INVENTION

[0002] The present invention relates to glaucoma shunts. More specifically, the present invention relates to minimally invasive glaucoma surgery shunts.

BACKGROUND OF THE INVENTION

[0003] Glaucoma is a medical term describing a group of progressive optic neuropathies characterized by degeneration of retinal ganglion cells and retinal nerve fibre layer and resulting in changes in the optic nerve head. Glaucoma is a leading cause of irreversible vision loss worldwide. With the aging population, it is expected that the prevalence of glaucoma will continue to increase. Despite recent advances in imaging and visual field-testing techniques that allow the establishment of earlier diagnosis and treatment initiation, significant numbers of glaucoma patients are undiagnosed and present late in the course of their disease. This can lead to irreversible vision loss, reduced quality of life, and a higher socioeconomic burden.

[0004] Glaucoma may be categorized as primary or secondary glaucoma. Primary glaucoma is often defined as glaucoma that develops due to an unknown cause, while secondary glaucoma may develop from a known cause, such as injury, cataract, tumour or diabetes. Primary or secondary glaucoma may also be classified as open angle or angle-closure. It is estimated that 64.3 million people worldwide have glaucoma, of which three-quarters are open-angle. Glaucoma, both open-angle and angle-closure, is the second leading cause of irreversible blindness worldwide, with approximately 8.4 million people becoming blind from the disease.

[0005] Glaucoma may have a significant impact on patients' quality of life, such as the ability to walk, drive or read. The psychological burden may increase with decreasing vision, along with a growing fear of blindness, social withdrawal, and depression. Measurable loss in quality of life and functionality may be observed even in the early stages of the disease and the impact increases as visual field (VF) loss progresses.

[0006] Current treatment or prevention includes prescription eye-drops, oral medications, laser treatment, surgery or a combination of any of these. There is a need in the art for a medical device that can treat or prevent glaucoma without the need for invasive surgery.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a shunt for minimally invasive glaucoma surgery which addresses at least some of the limitations of the prior art.

[0008] According to one aspect of the present invention, there is provided a glaucoma shunt comprising: an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body.

[0009] In one embodiment, the shunt further comprises an umbrella-shaped structure connected to and extending from the glaucoma shunt such that the umbrella-shaped structure abuts an inner wall of an eye when positioned in the eye.

[0010] In another embodiment, the shunt further comprises one or more anchors laterally extending away from the elongate body and spaced from the umbrella-shaped structure. The one or more anchors abut an outer surface of an eye when positioned in the eye.
[0011] In yet another embodiment, at least a portion of the inner surface comprises poly(methylmethacrylate), acrylic, silicone, polypropylene, Collamer™, or a combination thereof. In another embodiment, at least a portion of the umbrella-shaped structure comprises silicone, acrylic, polypropylene, Collamer™, or a combination thereof. In another embodiment, at least a portion of the outer surface comprises acrylic, silicone, polypropylene, Collamer™, or a combination thereof. In another embodiment, at least a portion of the one or more anchors comprises silicone, acrylic, polypropylene, Collamer™, or a combination thereof.
[0012] In yet another embodiment, the glaucoma shunt decreases intraocular pressure by drainage of aqueous humour via the lumen. Embodiments of the glaucoma shunt may be used to treat glaucoma, for example primary open angle glaucoma, secondary open angle glaucoma, mixed glaucoma, or juvenile glaucoma.
[0013] According to another aspect of the present invention, there is provided a glaucoma shunt comprising: an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body, wherein at least a portion of the inner surface comprises a first biocompatible material, and at least a portion of the outer surface comprises a second biocompatible material.
[0014] In some embodiments of the glaucoma shunt, the first biocompatible material is poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™, or combinations thereof. In such embodiments of the glaucoma shunt and others, the second biocompatible material is poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™, or combinations thereof.
[0015] According to another aspect of the present invention, there is provided a glaucoma shunt comprising: an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body, wherein at least a portion of the inner surface comprises poly(methylmethacrylate), and at least a portion of the outer surface comprises acrylic.
[0016] In another embodiment, the glaucoma shunt further comprises an umbrella-shaped structure connected to and extending from the glaucoma shunt such that the umbrella-shaped structure abuts an inner wall of an eye when positioned in the eye, and at least a portion of the umbrella-shaped structure comprises poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™or combinations thereof.
[0017] In yet another embodiment, the glaucoma shunt further comprises one or more anchors laterally extending away from the elongate body and spaced from the umbrella-shaped structure and at least a portion of the one or more anchors comprises poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™, or combinations thereof.
[0018] According to another aspect of the present invention, there is provided a method of decreasing intraocular pressure in an eye, the method comprising: inserting at least a portion of a glaucoma shunt into an anterior chamber of the eye, the glaucoma shunt comprising: an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body; and draining aqueous humour from the anterior chamber through the lumen.
[0019] In another embodiment of the present invention, the shunt further comprises an umbrella-shaped structure connected to and extending from the glaucoma shunt such that the umbrella-shaped structure abuts an inner wall of an eye when positioned in the eye. In another embodiment, the glaucoma shunt further comprises one or more anchors laterally extending away from the elongate body and spaced from the umbrella-shaped structure.

[0020] In yet another embodiment of the present invention, the method further comprising abutting at least a portion of the umbrella-shaped structure to the eye. In a further embodiment, abutting comprises abutting against a part of the eye, such as a cornea, or an iridocorneal angle. In another embodiment, abutting comprises abutting a portion of the umbrella-shaped structure against an inner surface of the part of the eye, such as the cornea or the iridocorneal angle and abutting a portion of the anchor against an outer surface of the part of the eye, such as the cornea or the iridocorneal angle.
[0021] In a further embodiment of the present invention, inserting comprises inserting the umbrella-shaped structure of the glaucoma shunt into the anterior chamber of the eye. In another embodiment, inserting comprises inserting the portion of the glaucoma shunt into the eye with the aid of a slit lamp. In yet another embodiment, inserting comprises inserting the glaucoma shunt under a conjunctiva of the eye. In some embodiments, inserting comprises inserting the glaucoma shunt under a Tenon's capsule of the eye.
[0022] In an embodiment of the present invention, the umbrella prevents migration of the glaucoma shunt while draining. In another embodiment, the one or more anchors prevent migration of the glaucoma shunt while draining.
[0023] According to another aspect of the invention, there is provided use of a glaucoma shunt for decreasing intraocular pressure in an eye, the use comprising: insertion of at least a portion of the glaucoma shunt into an anterior chamber of the eye, the glaucoma shunt comprising: an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body; and drainage of the aqueous humour from the eye through the lumen.
[0024] In an embodiment of the present invention, the shunt further comprises an umbrella-shaped structure connected to and extending from the glaucoma shunt such that the umbrella-shaped structure abuts an inner wall of an eye when positioned in the eye. In some embodiments, the use further comprising abutment of at least a portion of the umbrella-shaped structure to the eye. The shunt further comprises one or more anchors laterally extending away from the elongate body and spaced from the umbrella-shaped structure.
[0025] In some embodiments, the glaucoma shunt is abutted against a cornea or iridocorneal angle of the eye. In further embodiments, a portion of the umbrella-shaped structure is for abutment against an inner surface of the cornea or iridocorneal angle of the eye and a portion of the anchor is for abutment against an outer surface of the cornea or iridocorneal angle.
[0026] In some embodiments, the umbrella-shaped structure of the glaucoma shunt is for insertion into the anterior chamber of the eye. In further embodiments, the portion of the glaucoma shunt is for insertion into the eye with the aid of a slit lamp. In yet another embodiment, the glaucoma shunt is for insertion under a conjunctiva of the eye. In an embodiment, the glaucoma shunt is for insertion under a Tenon's capsule of the eye. In some embodiments, the umbrella-shaped structure prevents migration of the glaucoma shunt after insertion. In one embodiment, the one or more anchors prevent migration of the glaucoma shunt after insertion.
[0027] According to another aspect of the invention, there is provided an injection device for delivering a payload into a part of the eye. In one embodiment, the injection device comprises a body with a front end and an opposing rear end, an adjustable head extending from the front end of the body, comprising an outer wall with a hinge portion, the outer wall defining an inner cavity and a terminal end for insertion into the part of the eye; and an actuator mounted to the body and connected to the adjustable head such that movement of the actuator from a first position to a second position delivers the pay-load into the part of the eye.
[0028] In another embodiment of the injection device, the actuator is connected to the adjustable head via one or more pads located within the inner cavity. In some embodiments, the one or more pads abut the payload within the adjustable head. The one or more pads may be connected to the actuator such that movement of the actuator from the first position to the second position moves the

pads from a first pad position to a second pad position. Movement of the one or more pads to the second pad position may push the payload from the inner cavity to the part of the eye.
[0029] In further embodiments, the injection device comprises an inner needle mounted to the one or more pads. In some embodiments, the needle extends past the terminal end of the adjustable head when the one or more pads are in the second pad position. In further embodiments, at least a portion of the payload is within a gauge of the needle.
[0030] In some embodiments of the injection device, the actuator is a slider, button or roller.
[0031] In further embodiments of the injection device, the terminal end of the adjustable head defines one or more sharpened edges.
[0032] In even further embodiments of the injection device, the payload is the glaucoma shunt as described hereinabove. In some cases, the payload is a slow-release drug delivery system.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0033] These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings wherein:
[0034] FIG. **1**A shows a side elevation view of an embodiment of the glaucoma shunt in the deployed configuration;
[0035] FIG. **1**B shows a side elevation view of the glaucoma shunt of FIG. **1**A in the collapsed configuration;
[0036] FIG. **2** shows a front end view of the glaucoma shunt of FIG. **1**A;
[0037] FIG. **2**A shows a cross-sectional view taken along the **2**A-**2**A cross-section line in FIG. **2**;
[0038] FIG. **3** shows a cross-sectional view of an eye and the glaucoma shunt of FIG. **1**A; and
[0039] FIG. **4** shows a side elevation view of the glaucoma shunt of FIG. **1**A with an embodiment of an injector.
DETAILED DESCRIPTION
[0040] One or more illustrative embodiments have been described by way of example. Described herein are glaucoma shunts and methods of treatment of glaucoma. All references to embodiments, examples, aspects, formulas, compounds, compositions, apparatuses, kits and the like are intended to be illustrative and non-limiting.
[0041] In one embodiment there is provided a glaucoma shunt **10** for decreasing intraocular pressure in an eye. Shunt **10** comprises an elongate body **12** with an outer surface **14** and an inner surface **16**. Shunt **10** comprises an inner wall **17** that defines lumen **18**. The lumen **18** spans a length of elongate body **12**. Shunt **10** may comprise umbrella-shaped structure **20** mounted on and extending from shunt **10**. The umbrella-shaped structure **20** abuts an inner wall of the eye when positioned in the eye.
[0042] Glaucoma shunt **10** may be used to treat or prevent glaucoma, such as primary open angle glaucoma, secondary open angle glaucoma, juvenile glaucoma or mixed glaucoma. Without wishing to be bound by theory, shunt **10** may be used to treat glaucoma by decreasing intraocular pressure in the eye via drainage of aqueous humour through lumen **18**.
[0043] Inner membrane wall **34** refers to an inward facing surface of a part of the eye, such as a surface facing the anterior chamber. In some embodiments, the inner membrane wall **34** refers to the inner wall of the cornea, sclera, iridocorneal angle, or a combination thereof. Outer membrane surface **36** refers to an outer surface of a part of the eye, such as an outward facing surface (i.e. away from the anterior chamber) of the cornea, sclera, iridocorneal angle or a combination thereof. In some cases, the outer surface refers to parts of the conjunctiva or Tenon's capsule.
[0044] Referring to FIGS. **1** and **2**, elongate body **12** comprises a head **22** and an opposed tail **24**. Head **22** may define a suitably pointed shape with one or more slanted surfaces **26**. Lumen **18** may

extend through the elongate body **12** from head **22** to tail **24**. Lumen **18** may be defined by inner surface **16**. Lumen **18** may be free of any valves or obstructions to allow passive drainage of fluid, such as aqueous humour, from the eye. In some cases, lumen **18** and diameter **72** may be varied to modify the flow rate of aqueous humour through lumen **18** in use.

[0045] Referring to FIGS. **1**A, **1**B and **2**A, umbrella-shaped structure **20** can move between deployed and collapsed configurations. Umbrella-shaped structure **20** may be mounted on, or be integrated with, elongate body **12**. Umbrella-shaped structure **20** may extend in a direction substantially away from head **22** and toward tail **24**. Umbrella-shaped structure **20** has a suitable shape, such as a frustoconical shape and others. Migration of the glaucoma shunt **10** may be prevented by umbrella-shaped structure **20** when positioned in the eye. In example of a collapsed configuration of umbrella-shaped structure **20** is depicted in FIG. **1**B and an example of a deployed configuration of umbrella-shaped structure **20** is depicted in FIG. **1**A. In the deployed configuration, width **44**A of the umbrella-shaped structure **20** may be greater than width **44**B of the umbrella-shaped structure in the collapsed configuration. The collapsed configuration may be used during insertion into the eye of the patient. The umbrella-shaped structure **20** may then be deployed when it reaches anterior chamber **30**. Deployed umbrella-shaped structure **20** may then engage the inner membrane wall **34** and prevent migration of the umbrella-shaped structure, relative to the eye. In some cases, umbrella-shaped structure **20** may transition between the collapsed and deployed configurations by mechanical means, such as a lever or switch. In other cases, umbrella-shaped structure **20** may transition between the configurations by a passive mechanism, such as elasticity of the umbrella-shaped structure, or free movement. Umbrella-shaped structure **20** may be stored in a collapsed configuration in an injector.

[0046] Referring to FIG. **1**, shunt **10** may comprise one or more anchors **38** extending away from, and substantially perpendicular to, the elongate body **12**. Anchors **38** may be spaced from the umbrella-shaped structure **20** by width **46**. For example, anchors **38** may be spaced from umbrella-shaped structure **20** so that a part of the eye, such as the width of cornea **32**, may pass between anchors **38** and umbrella-shaped structure **20**. In some cases, width **46** is sized to accommodate the diameter of the cornea **32** or the sclera **48** (FIG. **3**). One or more anchors **38** may abut an outer membrane surface **36** of eye **28** in use. Migration of the glaucoma shunt **10** may be prevented by one or more anchors **38** in use. The shunt **10** may be locked in place relative to the eye by umbrella-shaped structure **20** and/or one or more anchors **38**. In the embodiments pictured, anchors **38** are shaped as bars or hooks, but other suitable shapes may be used, such as ledges, steps, or other shapes.

[0047] Referring to FIGS. **1** and **3**, in one embodiment there is described a method of decreasing intraocular pressure in an eye **28**, the method comprising inserting at least a portion of glaucoma shunt **10** into an anterior chamber **30** of eye **28**, abutting at least a portion of the umbrella-shaped structure **20** to an interior surface of eye **28**. In some embodiments, the umbrella-shaped structure **20** and anchor **38** may act to “lock” the shunt in position relative to the eye and prevent migration of the shunt **10** relative to the eye. Shunt **10** drains the aqueous humour from the anterior chamber **30** via the lumen **18**. Draining the aqueous humour may act to lower the intraocular pressure. The aqueous humour may drain into an appropriate subconjuctival area, such as a bleb **50** between the sclera and the Tenon's capsule or conjunctiva. In some cases, the aqueous humour is drained outside of the eye. The shunt **10** may be used to treat glaucoma, such as primary open angle or secondary open angle glaucoma by decreasing the intraocular pressure.

[0048] Referring to FIGS. **1** and **3**, at least part of shunt **10** is inserted into the eye **28** in use. Shunt **10** may be inserted through the cornea **32** or iridocorneal angle into the anterior chamber **30**. The anterior chamber may comprise aqueous humour, which may be drained through lumen **18** by passive means, such as diffusion. In certain embodiments, the shunt **10** may be inserted under the conjunctiva **40**. In further embodiments, the shunt **10** may be inserted under the Tenon's capsule **42** and conjunctiva **40** and into the iridocorneal angle. Shunt **10** may be inserted such that the umbrella

20 is within the anterior chamber **30** of the eye.
[0049] Referring to FIGS. **3** and **4**, insertion of shunt **10** may occur without the need for surgery. Shunt **10** may be inserted via an insertion device or injector **52**, such as the embodiment shown in FIG. **4**. Insertion device **52** comprises body **56**, actuator **58**, and an adjustable/flexible head **54**. The adjustable head **54** extends from a front end **57** of the body **56**. Body **56** may be shaped as a grip or handle to accommodate a user's hand.
[0050] A user of device **52** may position the flexible head **54** using the hinge portion of the outer wall **59**. The hinge portion **61** may comprise one or more hinges or joints, such as accordion hinge **54**A. Hinge **54**A may permit a right or left-handed user to operate the device. Other types of hinges known in the art may be used, such as living hinges and others. The hinge **54**A may allow a user to bend the head **54** at a suitable angle, relative to a central axis **62** of body **56**, such as 0-180° or 0-(−180°).
[0051] Actuator **58** may be provided as a slider **59**. The slider may be connected to pads **60** such that when the slider is moved along the axis **62**, the pads move in a direction along head **54** substantially towards terminal end **54**B, such as direction **64**. Pads **60** may rest against anchor **38** and may act to grip the outer surface of shunt **10** to hold it in place relative to the device **52**. One or more pads **60** may be connected to a needle **65**. Needle **65** may be hollow, with the shunt **10** within the needle **65**, and have a suitable shape with one or more sloped, sharpened edges. In some cases, needle **65** is shaped to correspond with terminal end **54**B of head **54**. Terminal end **54**B may define one or more sharpened edges that are sharp enough to perforate part of the eye, such as the sub conjunctiva, Tenon's capsule, cornea, sclera and/or iridocorneal angle of the eye.
[0052] Actuator **58** may be provided as a push button (not pictured). The button may be connected to pads **60** such that when the button is depressed between a first and second position, the pads move in a direction along head **54** substantially towards terminal end **54**B, such as direction **64**. When the button is released from the second position to the first position, the pads may move in a direction substantially towards hinge **54**A, such as direction **66**. The first and second positions may be reversed such that depressing the button moves the pads in direction **66**. The button may be positioned such that a user can operate the button with the user's thumb.
[0053] In another embodiment, actuator **58** may be provided as a roller (not pictured). The roller may be connected to pads **60** such that when the roller mechanism is moved from a first position to a second position, such as a right side to a left side (for a right-handed user), the pads move in a direction along head **54** substantially towards terminal end **54**B, such as direction **64**. When the roller is moved from the second position back to the first position, the pads may move in a direction substantially towards hinge **54**A, such as direction **66**. The first and second positions may be reversed for a left-handed user. The roller may move in a direction perpendicular to axis **62** in use.
[0054] The adjustable head **54** may be inserted into the eye, such as subconjunctival or under the Tenon's capsule. A user then operates the actuator **58**, such as slider or a button, which is connected to operate one or more pads **60**. When the head **54** is in position (i.e. under the conjunctiva but before breaching the outer wall of the eye) the user may operate the actuator **58**. The actuator **58** may move pads **60** and needle **65** through the outer wall of the eye (such as the cornea and/or sclera). When the actuator **58** has moved from a first position, such as a rear **55** of the device in cases of a slider, to a second position, such as indentation **56**A, the pads **60** may disengage from the payload, such as shunt **10**. Once the pads **60** have disengaged, the actuator **58** may be moved back from the second position to the first position, thereby causing the pads **60** and needle **65** to move in a direction away from the eye, such as direction **66**. The device **52** may be removed, leaving the payload, such as shunt **10**, in the eye.
[0055] Insertion of glaucoma shunt **10** may occur with the aid of a slit lamp or surgical microscope. In some cases, shunt **10** is inserted ab externo or ab interno.
[0056] Referring to FIG. **3**, shunt **10** may abut against cornea **32**, such as in the anterior chamber,

of eye **28**. Umbrella-shaped structure **20** may abut against an inner membrane surface **34** of cornea **32** after insertion. The shunt **10** may pass through the iridocorneal angle, in use. The iridocorneal angle may be understood as an angular recess between the cornea and the anterior surface of the attached margin of the iris. Anchor **38** may abut against an outer membrane surface **36** of cornea **32**, such as under tenon's capsule at the limbus external to cornea. Contacting or abutting the inner membrane surface **34** and/or outer membrane surface **36** may decrease migration of shunt **10** relative to eye **28**.

[0057] At least one or more portions of shunt **10** may comprise one or more biocompatible materials. In some embodiments, all of shunt **10** may comprise one or more biocompatible materials. Examples of suitable material include poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™ and others. In some cases, at least a portion of the inner surface **16** comprises PMMA. Inner surface **16** may be comprised entirely of PMMA. A portion of the first end **22**, such as the tip of the shunt and slanted surfaces **26**, may comprise PMMA. All or at least a portion of the umbrella-shaped structure **20** may comprise silicone. All or at least a portion of the outer surface **14** may comprise acrylic. All or at least a portion of the one or more anchors **38** may comprise silicone.

[0058] In some embodiments, a front portion **76** comprising the first end **22** and umbrella-shaped structure **20** may comprise a first biocompatible material, such as poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™, or combinations thereof. In such embodiments and others, a back portion **74** comprises a second biocompatible material, such as poly(methylmethacrylate) (PMMA), silicone, acrylic, hydrophobic acrylate, hydrophilic acrylate, COLLAMER™ or combinations thereof. Front portion **76** may be a portion that is inserted into the eye in use. Back portion **74** may be a portion that is located in the sub conjunctival area in use. In a preferred embodiment, the front portion **76** comprises silicone as the first biocompatible material and the back portion **74** comprises acrylic.

[0059] Shunt **10** may be a microshunt. Shunt **10** may have a suitable length, such as about 1 to about 50 mm, such as 8 mm or 8.5 mm. Shunt **10** has have a suitable outer diameter **70**, such as about 135 to about 400 μm, for example 165 μm or 170 μm. Shunt **10** has a suitable inner diameter **72**, such as about 20 to about 305 μm, for example 50 μm. Shunt **10** may have a suitable width or spacing **46** between the umbrella-shaped structure **20** and anchor **38** to accommodate a part of the eye, such as the cornea or sclera. Spacing **46** may be a suitable width, such as about 0.3 to about 0.8 mm, for example 0.5 mm. The actual size of the shunt may be determined based on the application. For example, different inner diameters may be used to effect different flow rates through the lumen. In some cases, a narrower lumen will result in a slower rate of drainage from the anterior chamber.

[0060] Suitable lengths may include a range of about 0.1 to about 200 mm or any value therebetween (optionally rounded to the nearest 0.1), or any subrange spanning between any two of these values, such as 8.5mm or 25.4 mm. For example, lengths of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10, 10.5, 11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15, 15.5, 16, 16.5, 17, 17.5, 18, 18.5, 19, 19.5, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200 mm and others are considered.

[0061] Suitable inner diameters and outer diameters may include a range of about 0.1 to about 2000

μm or any value therebetween (optionally rounded to the nearest 0.1), or any subrange spanning between any two of these values, such as 135-195 μm or 20-80 μm. For example, diameters of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200 μm and others are considered.

[0062] Shunt **10** may be used in combination with other suitable treatments. Some examples include cataract surgery, prescription eye-drops, oral medication, laser treatment, trabeculectomy, other shunts, surgery and others. Shunt **10** may be used in combination with metabolites such as MMC (mitomycin C), 5-FU (5-fluorouracil), Anti-Vascular Endothelial Growth Factor (AntiVEGF) treatments, such as Avastin/Lucentis/Eylea, and others.

[0063] Shunt **10** and/or injector **52** may be used for delivering drugs and/or drug delivery devices into the eye. For example, the payload within injector **52** may be a slow release drug delivery device. Suitable ocular drug delivery devices known in the art may be used, for example those described in Patel, A. et al. “Ocular drug delivery systems: An overview.” *World journal of pharmacology* vol. 2, 2 (2013): 47-64, herein incorporated by reference. Shunt **10** may be used to deliver drugs into a part of the eye, for example through lumen **18**.

[0064] In the event of conflicting information and statements between any reference referred to or incorporated herein and the present disclosure, the present disclosure will act as the guiding authority.

[0065] The present invention has been described with regard to one or more embodiments. However, it will be apparent to persons skilled in the art that a number of variations and modifications can be made without departing from the scope of the invention as defined in the claims.

Claims

1. A method for delivering a glaucoma shunt into an eye tissue layer, the method comprising: providing an injection device including a body with a front end and an opposing rear end, the body extending along a first axis, an adjustable head connected to the front end of the body and secured to the front end of the body by an adjustable joint, a needle which is mounted to the adjustable head, wherein the needle is hollowed, and a glaucoma shunt stored within the hollow needle; adjusting the adjustable head via the adjustable joint to extend the adjustable head along a second axis while the adjustable head remains connected to the front end of the body; inserting the needle into an anterior chamber of the eye and through an eye tissue layer; and delivering the glaucoma shunt in the eye tissue layer.

2. The method of claim 1, wherein the adjustable head comprises an outer wall defining an inner cavity, and wherein the injection device further comprises an actuator connected to the adjustable head via an internal structure located within the inner cavity.

3. The method of claim 2, wherein moving the actuator from one position to another position causes the needle to move relatively to the adjustable head in a direction away from the eye.

4. The method of claim 3, wherein the internal structure operatively couples the actuator to the needle.

5. The method of claim 3, wherein movement of the needle in a direction away from the eye leaves

the glaucoma shunt in the eye tissue layer.

6. The method of claim 1, wherein the glaucoma shunt comprising an elongate body with an outer surface and an inner surface, the elongate body comprising an inner wall that defines a lumen spanning a length of the elongate body.

7. The method of claim 2, wherein the actuator is a slider, button, or roller.

8. The method of claim 2, wherein the actuator is positioned such that a user can operate the actuator with a finger.

9. The method of claim 6, wherein the glaucoma shunt further comprises one or more anchors laterally extending away from the elongate body.

10. The method of claim 9, wherein delivering the glaucoma shunt further comprises abutting the one or more anchors against a surface of the cornea or an iridocorneal angle of the eye.

11. The method of claim 1, wherein inserting the needle further comprises inserting the needle with the aid of a slit lamp or surgical microscope.

12. The method of claim 1, wherein delivering the glaucoma shunt further comprises inserting the glaucoma shunt under a conjunctiva of the eye.

13. The method of claim 1, wherein delivering the glaucoma shunt further comprises inserting the glaucoma shunt under a Tenon's capsule of the eye.

14. The method of claim 9, wherein the one or more anchors prevent migration of the glaucoma shunt after delivery relative to the eye.

15. The method of claim 1, wherein the adjustable joint includes a hinge portion on an outer wall of the adjustable head.

16. The method of claim 15, wherein the hinge portion includes one or more hinges or joints.

17. The method of claim 1, wherein adjusting the adjustable head via the adjustable joint is performed to obtain an angle at the adjustable joint from 0 to 180° or 0 to −180°.

18. The method of claim 1, wherein delivering the glaucoma shunt is performed ab externo.

19. The method of claim 1, wherein the glaucoma shunt is stored in the hollow needle in a collapsed state.

20. The method of claim 1, wherein the glaucoma shunt is in a deployed state upon delivery of the glaucoma shunt in the eye tissue layer.