

implantation, typical methods of implantation all require relatively invasive surgical procedures, pose a risk of excessive trauma to the eye, and require excessive handling of the implant. For example, in a typical method for placement in the vitreous, an incision is made through the sclera, and the implant is inserted into and deposited at the desired location in the vitreous, using
5 forceps or other like manual grasping device. Once deposited, the forceps (or grasping device) are removed, and the incision is sutured closed. Alternatively, an incision can be made through the sclera, a trocar can be advanced through the incision and then the implant can be delivered through the trocar. Similar methods can be employed to deliver implants to other locations, e.g., implantation in the anterior chamber of the eye through an incision in the cornea.

10 **[0006]** There are numerous drawbacks of such techniques for implant delivery. Extensive handling of the implant is necessitated in these techniques, creating a risk that the implant will be damaged in the process. Many implants are polymer-based and are relatively fragile. If portions of the implants are damaged and broken-off, the effective therapeutic dose delivered by the implant once placed will be significantly altered. In addition, it becomes inherently difficult
15 using these methods to achieve reproducible placement from patient to patient. Additionally, all of these techniques require an incision or puncture in the eye large enough to require suturing. Thus, such techniques are typically performed in a surgical setting.

[0007] Many considerations affect the design and efficacy of an implant delivery device. First, it is important to ensure that the implant is consistently delivered to the subject with each
20 application. Second, because implant therapy often requires numerous applications, the cost of providing the implant should also be considered.

[0008] Based on the foregoing, a need for a more facile, convenient, less invasive, and less traumatic means for delivering implants into the eye and other anatomy remains. In addition, a need for a more controlled means of delivering implants also remains. The innovations described
25 herein solve these unmet needs and provide additional advantages.

SUMMARY OF THE DISCLOSURE

[0009] According to a first aspect of the present invention, there is provided an implant delivery device comprising an elongated body, a cannula, a mandrel, a front shuttle, a dispense button and
30 a leaf spring. The elongated body has a proximal end and a distal end. The cannula is carried by the body and has a distal portion extending from the distal end of the body. The cannula is sized and configured to receive an implant therein. The mandrel is slidably received within the cannula and movable from a retracted position, in which an implant is retained inside the cannula, to a distally advanced position, in which the implant is ejected from the cannula by the mandrel. The
35 front shuttle is coupled to the mandrel and is configured to drive

slide is in the extended position. In some embodiments, the slide is configured to be locked in the retracted position until the lock pin is removed.

[0014] In some embodiments, the shuttle and the leaf spring are configured to return the dispense button to the extended position if the dispense button is not fully moved to the

5 depressed position. The device may be configured to emit a soft click when the dispense button reaches the depressed position.

[0015] In some embodiments, the cannula is provided with a retaining feature configured to releasably retain an implant within the cannula until the implant is pushed out by the mandrel.

The retaining feature may comprise a cutout section in the cannula which exposes at least a
10 portion of the implant when loaded in the cannula, and a retention member configured to extend into the cutout section and urge the implant against an opposite wall of the cannula. In some embodiments, the retention member is a flexible arm that puts a resilient force on the implant. The flexible arm may be mounted on a retention hub that concentrically surrounds a portion of the cannula. In some embodiments, the cutout section in the cannula has a longitudinal length
15 that is nominally the same as a longitudinal length of the implant. The flexible arm may comprise an implant contact surface having a longitudinal length that is nominally the same as the longitudinal lengths of the implant and the cutout section. In some embodiments, the device further comprises a preloaded implant.

[0016] According to a second aspect of the present invention, there is provided an implant

20 delivery device comprising an elongated body, a cannula, a mandrel, a front shuttle, a rear shuttle, a dispense button, a leaf spring, a cap, a sharps protection slide and a lock pin. The elongated body has a proximal end, a distal end and a longitudinal axis. The cannula is carried by the body and has a distal portion extending from the distal end of the body. The cannula is sized and configured to receive an implant therein. A mandrel is slidably received within the cannula
25 and movable from a retracted position, in which an implant is retained inside the cannula, to a distally advanced position, in which the implant is ejected from the cannula by the mandrel. The front shuttle is movable in a longitudinal direction and coupled to the mandrel. The front shuttle is configured to drive the mandrel distally from the retracted position to the distally advanced position. The rear shuttle is movable in a longitudinal direction separately from the front shuttle.
30 The dispense button is located on a top side surface of the elongated body and is generally movable in a radially inward direction when moving from an extended position to a depressed position. The leaf spring has a first end pivotably connected to the front shuttle, a second end pivotably connected to the rear shuttle, and a convex mid-portion contacting a surface of the dispense button such that when the button is moved toward the depressed position, the leaf
35 spring becomes less curved and urges the front shuttle apart from the rear shuttle. The dispense

button comprises a cam surface that contacts a mating cam surface on the rear shuttle to drive the rear shuttle and leaf spring distally when the dispense button is moving towards the depressed position. The rear shuttle comprises a locking feature that engages with a mating locking feature on the dispense button to lock the dispense button in the depressed position. The cap is
5 configured to releasably cover the distal end of the body and the distal portion of the cannula when the cap is attached to the body. The sharps protection slide is movable from a retracted position to a distally extended position in which the slide at least partially covers a distal tip of the cannula. The lock pin is configured to pass through the cap, the sharps protection slide, the rear shuttle and the front shuttle to prevent these components from moving until the lock pin is
10 removed. The delivery device is configured to be operated by a user removing the lock pin, removing the cap, moving the dispense button from the extended position to the depressed position, thereby moving the rear shuttle distally and deflecting the leaf spring, both of which urge the front shuttle towards the distal end of the body and cause the mandrel to move from the retracted position to the distally advanced position to eject the implant from the distal portion of
15 the cannula. The user may then move the sharps protection slide from the retracted position to the distally extended position.

[0017] In some embodiments, the first shuttle, the second shuttle and the leaf spring are configured to return the dispense button to the extended position if the dispense button is not fully moved to the depressed position. The device may be configured to emit a soft click when
20 the dispense button reaches the depressed position.

[0018] In some embodiments, the device further comprises a retention hub that concentrically surrounds a portion of the cannula. In these embodiments, the retention hub has a flexible arm that extends through a cutout section in the cannula to resiliently urge an implant inside the cannula against an opposite wall of the cannula, thereby releasably retaining the implant within
25 the cannula until the implant is pushed out by the mandrel.

[0019] There is disclosed a method of delivering an implant includes the step of providing an implant delivery device. In this method, the implant delivery device includes an elongated body, a cannula, a mandrel, a front shuttle, a dispense button, a leaf spring, a cap and a lock pin. The elongated body has a proximal end and a distal end. The cannula is carried by the body, has a
30 distal portion extending from the distal end of the body and carries an implant therein. The mandrel is slidably received within the cannula. The front shuttle is coupled to the mandrel. The dispense button is located on the elongated body. At least a portion of the leaf spring spans between the dispense button and the front shuttle. The cap is removably attached to the distal end of the body and covers the distal portion of the cannula when the cap is attached to the body. The
35 lock pin is configured to pass through the cap and the

CLAIMS

What is claimed is:

1. An implant delivery device comprising:
5 an elongated body having a proximal end and a distal end;
a cannula carried by the body and having a distal portion extending from the distal end of
the body, the cannula being sized and configured to receive an implant therein;
a mandrel slidably received within the cannula and movable from a retracted position, in
which an implant is retained inside the cannula, to a distally advanced position, in
10 which the implant is ejected from the cannula by the mandrel;
a front shuttle coupled to the mandrel and configured to drive the mandrel from the
retracted position to the distally advanced position;
a dispense button movable from an extended position, in which the mandrel remains in
the retracted position, to a depressed position, in which the mandrel is moved toward
15 the distally advanced position; and
a leaf spring, at least a portion of which spans between the dispense button and the front
shuttle,
wherein the delivery device is configured to be operated by a user moving the dispense
button from the extended position to the depressed position, thereby deflecting the
20 leaf spring and urging the front shuttle towards the distal end of the body and
causing the mandrel to move from the retracted position to the distally advanced
position to eject the implant from the distal portion of the cannula.
2. The device of claim 1, wherein the dispense button is located on a top side surface of the
25 elongated body and generally moves radially inward when moving from the extended position to
the depressed position.
3. The device of claim 1, wherein the device further comprises a rear shuttle that is
separately movable with respect to the front shuttle.
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4. The device of claim 3, wherein the leaf spring spans between the front shuttle and the
rear shuttle and has a mid-portion that contacts the dispense button.
5. The device of claim 3, wherein the leaf spring is pivotably connected to the front shuttle
35 with a first pin and pivotably connected to the rear shuttle with a second pin.

6. The device of claim 3, wherein the dispense button comprises a cam surface that contacts a mating cam surface on the rear shuttle to drive the rear shuttle distally when the dispense button is moving from the extended position to the depressed position, thereby urging the leaf spring, the front shuttle and the mandrel further towards the distal end of the body.
7. The device of claim 3, wherein the rear shuttle comprises a locking feature that engages with a mating locking feature on the dispense button to lock the dispense button in the depressed position.
8. The device of claim 3, wherein the front shuttle and the rear shuttle have portions that overlap one another, and wherein the device further comprises a lock pin that extends from outside the elongated body and into the overlapping shuttle portions to prevent the front shuttle and the rear shuttle from moving relative to the body until the lock pin is removed.
9. The device of claim 8, wherein the device further comprises a cap configured to releasably cover the distal end of the body and the distal portion of the cannula when the cap is attached to the body, the cap being configured to be locked onto the body until the lock pin is removed.
10. The device of claim 8, wherein the device further comprises a sharps protection slide that is movable from a retracted position to a distally extended position in which the slide at least partially covers a distal tip of the cannula.
11. The device of claim 10, wherein the sharps protection slide covers a bottom portion of the cannula along a longitudinal length extending at least to the distal tip of the cannula and leaves a top portion visually exposed but not reachable by a flat object when the slide is in the extended position.
12. The device of claim 10, wherein the slide is configured to be locked in the retracted position until the lock pin is removed.
13. The device of claim 1, wherein the shuttle and the leaf spring are configured to return the dispense button to the extended position if the dispense button is not fully moved to the depressed position.

14. The device of claim 13, wherein the device is configured to emit a soft click when the dispense button reaches the depressed position.
- 5 15. The device of claim 1, wherein the cannula is provided with a retaining feature configured to releasably retain an implant within the cannula until the implant is pushed out by the mandrel.
- 10 16. The device of claim 15, wherein the retaining feature comprises a cutout section in the cannula which exposes at least a portion of the implant when loaded in the cannula, and a retention member configured to extend into the cutout section and urge the implant against an opposite wall of the cannula.
- 15 17. The device of claim 16, wherein the retention member is a flexible arm that puts a resilient force on the implant.
18. The device of claim 17, wherein the flexible arm is mounted on a retention hub that concentrically surrounds a portion of the cannula.
- 20 19. The device of claim 17, wherein the cutout section in the cannula has a longitudinal length that is nominally the same as a longitudinal length of the implant.
- 25 20. The device of claim 19, wherein the flexible arm comprises an implant contact surface having a longitudinal length that is nominally the same as the longitudinal lengths of the implant and the cutout section.
21. The device of claim 1, wherein the device further comprises a preloaded implant.
- 30 22. An implant delivery device comprising:
an elongated body having a proximal end, a distal end and a longitudinal axis;
a cannula carried by the body and having a distal portion extending from the distal end of the body, the cannula being sized and configured to receive an implant therein;
a mandrel slidably received within the cannula and movable from a retracted position, in which an implant is retained inside the cannula, to a distally advanced position, in
35 which the implant is ejected from the cannula by the mandrel;

a front shuttle movable in a longitudinal direction and coupled to the mandrel, the front shuttle configured to drive the mandrel distally from the retracted position to the distally advanced position;

a rear shuttle movable in a longitudinal direction separately from the front shuttle;

5 a dispense button located on a top side surface of the elongated body and generally movable in a radially inward direction when moving from an extended position to a depressed position;

a leaf spring having a first end pivotably connected to the front shuttle, a second end pivotably connected to the rear shuttle, and a convex mid-portion contacting a

10 surface of the dispense button such that when the button is moved toward the depressed position, the leaf spring becomes less curved and urges the front shuttle apart from the rear shuttle, wherein the dispense button comprises a cam surface that contacts a mating cam surface on the rear shuttle to drive the rear shuttle and leaf spring distally when the dispense button is moving towards the depressed position,

15 wherein the rear shuttle comprises a locking feature that engages with a mating locking feature on the dispense button to lock the dispense button in the depressed position;

a cap configured to releasably cover the distal end of the body and the distal portion of the cannula when the cap is attached to the body;

20 a sharps protection slide that is movable from a retracted position to a distally extended position in which the slide at least partially covers a distal tip of the cannula; and

a lock pin configured to pass through the cap, the sharps protection slide, the rear shuttle and the front shuttle to prevent these components from moving until the lock pin is removed,

25 wherein the delivery device is configured to be operated by a user removing the lock pin, removing the cap, moving the dispense button from the extended position to the depressed position, thereby moving the rear shuttle distally and deflecting the leaf spring, both of which urge the front shuttle towards the distal end of the body and cause the mandrel to move from the retracted position to the distally advanced

30 position to eject the implant from the distal portion of the cannula, and moving the sharps protection slide from the retracted position to the distally extended position.

23. The device of claim 22, wherein the first shuttle, the second shuttle and the leaf spring are configured to return the dispense button to the extended position if the dispense button is not

35 fully moved to the depressed position.

24. The device of claim 23, wherein the device is configured to emit a soft click when the dispense button reaches the depressed position.

- 5 25. The device of claim 22, wherein the device further comprises a retention hub that concentrically surrounds a portion of the cannula, the retention hub having a flexible arm that extends through a cutout section in the cannula to resiliently urge an implant inside the cannula against an opposite wall of the cannula, thereby releasably retaining the implant within the cannula until the implant is pushed out by the mandrel.

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