

OCULAR PLATFORMS AND SURGICAL TOOLS

TECHNICAL FIELD

[001] Embodiments of the invention relate to ocular platforms and surgical tools, and for example to guidance of such surgical tools, such as retrobulbar surgical tools, via the platforms to their targeted locations on the eye.

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BACKGROUND

[002] The human eye has several layers, including the sclera which comprises a white outer layer of the eye. The sclera provides support and protection to the choroid layer and to the retina which comprises the innermost layer. The choroid
10 layer includes vasculature that provides oxygen and nourishment to the retina. The retina has a light sensitive tissue that includes light sensitive cells responsible for creating the visual information and transmitting it to the brain via axons of the retinal ganglion cells which forms the optic nerve. The macula which is the area of the retina responsible for visual acuity is located at the center of the retina at the
15 anterior aspect of the posterior pole of the eye and is centered on an optic axis passing through the centers of the lens and cornea of the eye.

[003] Various ocular diseases that involve the retina may lead to visual impairment, some of them i.e. macular degeneration or genetic retinal diseases effect the retina directly and some of them occur due to pathologic changes in
20 nearby tissues such as the sclera as is the case in pathologic myopia. In this common pathology the sclera weakens forming an abnormal protrusion of the posterior eyeball wall to form a staphyloma. This lengthening cause thinning of the choroid and retina and may lead to several pathologies in these tissues

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[004] Treating diseases and/or degenerations in the posterior portion of the eye either within the eye or involving the outer wall of the eye may be challenging. A retrobulbar approach which is the term used to describe a method to reach the eye from behind in order to treat those diseases is especially challenging as the eye is strictly positioned within the orbit bones. Nevertheless retrobulbar approach may add a more physiologic and more precise modality

SUMMARY

[005] The following embodiments and aspects thereof are described and illustrated in conjunction with systems, tools and methods which are meant to be exemplary and illustrative, not limiting in scope.

[006] In an embodiment a device and/or method for treating scleral staphyloma reinforcement (cross linking) to prevent and reduce the staphyloma is provided. In another embodiment, a device and/or method may be provided for injecting medical materials such as drugs, devices, radioactive components, stem cells or gene carriers into precise locations in the posterior parts of the eye and to the optic nerve and adjacent structures.

[007] Embodiments of devices and/or methods described herein provide advantages of performing procedures, such as administration of injections (or the like), to posterior regions of the eye, which can be performed through the sclera - with a reduced likelihood of causing potential complications to ocular structures, such as retinal detachment.. Such procedures, which otherwise are performed through the anterior portion of the eye, when performing e.g. administration of injections may spread the injected material through the vitreous thus affecting not only the desired tissue but other intra and extra ocular tissues as well . Furthermore – optic nerve sheath fenestration and/or injections near or even directly into the optic nerve in accordance with the presented embodiments, may spare open surgical approach of the orbit.

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[008] In addition to the exemplary aspects and embodiments described above, further aspects and embodiments will become apparent by reference to the figures and by study of the following detailed descriptions.

5 BRIEF DESCRIPTION OF THE FIGURES

[009] Exemplary embodiments are illustrated in referenced figures. It is intended that the embodiments and figures disclosed herein are to be considered illustrative, rather than restrictive. The invention, however, both as to organization and method of operation, together with objects, features, and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanying figures, in which:

[010] **Figs. 1 and 2** schematically show an eyeball platform in accordance with an embodiment of the present invention;

[011] **Figs. 3 and 4** schematically show an embodiment of an eyeball platform being fitted to a human eyeball;

[012] **Fig. 5** schematically shows a top view generally along an optic axis of an eye of an embodiment of an eyeball platform securely fitted to a human eyeball;

[013] **Fig. 6** schematically shows a human eyeball in isolation when securely fitted with an embodiment of an eyeball platform;

[014] **Figs. 7 to 22** schematically show various embodiments of eyeball platforms during various surgical procedures;

[015] **Figs. 23A, 23B, 24A and 24B** schematically show an eyeball platform in accordance with an embodiment of the present invention;

[016] **Fig. 25** schematically shows a block diagram of a method of controlling advancement of a tool through the platform towards the eye; and

[017] **Figs. 26 to 30** schematically show an eyeball platform in accordance with yet another embodiment of the present invention, and embodiments of a surgical tool to be used with the various eyeball platform embodiments disclosed herein.

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[018] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference
5 numerals may be repeated within the figures to indicate like elements.

DETAILED DESCRIPTION

[019] Attention is first drawn to Figs. 1 and 2 that schematically show an eyeball platform 10 in accordance with an embodiment of the present invention.
10 Platform 10 in this example is shown having a framework 11 generally formed about a central axis X that defines opposing anterior and posterior axial directions.

[020] Framework 11 may substantially enclose a space surrounding axis X or may lie on, or form a skeletal structure substantially included in, an imaginary surface that encloses a space surrounding axis X. In the views provided herein the
15 latter is shown.

[021] Surfaces defined by framework 11 may be suited to form a substantial unobstructed line of sight along axis X and thus along a visual axis of an eye being examined/observed/treated by a physician through platform 10. Such surfaces may take form of various shapes, such as cylindrical, funnel, coned (and the like).

[022] In the shown examples, framework 11 is embodied as a generally funnel or coned shaped formation that is formed about axis X and converges/tapers in the posterior direction. In the shown example, such funnel or coned formation may optionally be embodied by a series of axially spaced apart ring-like members that diminish in diameter in the posterior direction, and are generally parallel one to the
20 other. In certain cases, respective angles between such ring-like members can be
25 adjusted in relation to an imaginary plane perpendicular to axis X and/or about axis X.

[023] In the optional embodiment that is shown, the coned formation includes a series of three ring-like members, namely a base ring member 12 at an anterior side

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of the framework or platform, a terminal ring member 14 at a posterior side of the framework or platform, and an intermediate ring member 16 that in this example is located more proximal to the terminal ring member 14. The ring members are kept spaced apart in this example by shaft like spacers 17.

5 [024] A relative axial spacing between the intermediate and terminal ring members 14, 16 may be adjusted by means of a toggle 15, and a possible anchoring sheath 18 may be located about the intermediate ring member 16, while being attached to the intermediate ring member.

[025] Platform 10 in addition includes an introducing channel or conduit 20
10 (from hereon referred to as “conduit”) and an adjustment mechanism 22 that is fitted adjacent to the base ring member 12 and is adapted to adjust an orientation of the conduit 20 within the framework 11. In the shown example, the adjustment mechanism 22 includes first and second biasing members 221, 222 that are arranged to bias and/or adjust the orientation of conduit 20 along two generally perpendicular
15 first and second axes B1, B2 relative to framework 11.

[026] The first biasing member 221 may be adapted to move conduit 20 in a generally radial direction along axis B1 relative to the base ring member and by that possibly urge tilting of the conduit generally along axis B1. The second biasing member 222 may be adapted to move conduit 20 in a generally tangential direction
20 relative to the base ring member along axis B2 and by that possibly urge tilting of the conduit generally along axis B2.

[027] Fig. 2 illustrates the conduit 20 being slightly tilted by the first biasing member 221 relative to the orientation of the conduit 20 as seen in Fig. 1.

[028] With attention drawn to Fig. 2, conduit 20 can be seen extending along an
25 S curve that may be designed to have varying curvatures in a non-deformed state. Conduit 20 may include a first section 201 that may be generally straight, which transitions in a posterior direction into a second section 202 that may be designed to have an increased curvature that extends away from axis X. A rate of change of the curvature of the second section may initially increase as it extends away from the

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first section in the posterior direction and may then gradually decrease before possibly curving in an opposing direction (not shown in Fig. 2).

[029] In certain embodiments the adjustment mechanism 22 may be adapted to bear against the conduit 20 at a location along the conduit's first section 201 in order to alter the conduit's orientation relative to the coned formation of the framework 11. The first section 201 of the conduit may be oriented generally transverse to the platform's axis X possibly slanting in a general posterior direction towards axis X until transitioning into second section 202 that slants in a general opposite direction away from axis X as the second section 202 of the conduit advances in the posterior direction.

[030] Attention is drawn to figs. 23A, 23B, 24A and 24B to provide views of an embodiment of a platform 100, generally similar to platform 10. The views provided with respect to platform 100 reveal the manner in which the conduit 20 may be anchored/hinged at its lower side to framework 11.

[031] In this embodiment, the platform is seen being provided with a hinge arrangement 24 that is arranged to secure a lower/posterior region of the conduit 20 at a pivot 241 that remains substantially fixed in place relative to the framework of the platform.

[032] When anchored to an eyeball, the platform's pivot 241 may be arranged to be situated generally at the location of an incision formed in the Tenon capsule through which the conduit enters the subtenon space underneath the Tenon capsule (see incision 88 indicated in Fig. 4). Situating the pivot 241 in that position reduces the likelihood of pulling out from the subtenon space or from causing further damage to the Tenon capsule as the conduit 20 is tilted.

[033] The hinge arrangement 24 in this example includes an arm 242 that is fixed at its upper/anterior end to intermediate ring member 16 and includes pivot 241 at its lower/posterior end. In an embodiment, pivot 241 may take form of a "spherical bearing" that permits angular rotation about a central point in two

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orthogonal directions. Also seen in Figs. 24 is the provision of an opening 33 within terminal ring member 14 through which the conduit 20 is arranged to pass.

[034] In the figures that are provided the toggles 15, 221, 222 are shown possibly being arranged for manual manipulation by a physician, however in other
5 embodiments (not shown) the toggles may be manipulated by a controller. Such control may be implemented as an open loop control system or as a closed loop control system as illustrated by the block diagram provided in Fig. 25.

[035] Attention is drawn to Fig. 25 illustrating a possible method 1000 of operating the toggles by a controller in a closed loop control system. Block 1001
10 illustrates an initial step of the method where a 'target position' is set for a tool introduced through a platform such as 10, 100 (or 1000 disclosed herein below). Such 'target position' may be a staphyloma, an optic nerve or any posteriorly located adjacent structures. The possible subsequent steps described in method 1000 may be aimed at adjusting (possibly continuously adjusting) a 'tip position' 1006 of the
15 tool until it reaches the 'target position'.

[036] In a first possible step 1002 a controller that receives the 'target position' may be arranged in a subsequent step 1003 to activate actuators/toggles controlling tilting of the conduit and possibly advancement of a tool being introduced through the conduit towards the eye.

[037] An imaging device for direct visualization of the posterior pole such as a
20 microscope, or indirect imaging modalities such as ultrasound or oct may detect the exact position of the surgical tool tip by visualization of the transillumination produced by the instruments tip which may be equipped with lighting source enabling transillumination of the adjacent tissue or via indentation of the sclera with
25 a flexible tip or detected by the indirect modalities listed above, in a subsequent step 1004, such detection may then be communicated, possibly via an AI system in step 1005 – so that a true position of the tool is received at the controller. This loop may continue until the 'tip position' generally matches the 'target position'.

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[038] Attention is drawn to Fig. 3 and 4 illustrating possible steps that may be taken in order to assume an anchored state of the platform 10 to an eyeball of a patient. As seen in Fig. 4, in the anchored state the platform may be engaged with the eyeball via the framework's terminal ring member 14. Substantial secure
5 anchoring to the eyeball may be assisted by vacuum attachment means located at terminal ring member 14 and/or by any other suitable means such as pins that attach to the tissue of the eyeball (or the like).

[039] In certain embodiments, once engaged with the eyeball, the anchoring sheath 18 possibly included in the platform may be suitably placed on surrounding
10 facial regions, possibly adhered (e.g. self-adhered) to the skin of the patient by adhesive included upon sheath 18 and/or added to the sheath – to thus stabilize the platform in its anchored position with the aid of the skeletal orbital rim and/or facial bones. As indicated by the dashed arrow in Fig. 4, in the anchored state of the platform, a posterior tip section 77 of the conduit (see indicated in Fig. 3) may be
15 arranged to pass through an incision 88 formed in the Tenon capsule to be situated below the Tenon capsule, which envelopes the eyeball. In this position, surgical tools introduced via the conduit towards the treatment zone may be guided to advance below the Tenon capsule in order to reach regions of the eyeball such as retrobulbar regions of the eye, where therapeutic or surgical treatment is required,

[040] Attention is drawn to Fig. 5 showing a top view generally along an optic axis of an eye of platform 10 in its anchored state. A surgeon attaching the platform to an eyeball of a patient, may be guided to generally align axis X of the platform to the optic axis of the eye, and therefore axis X may be taken to also represent the eye's optic axis.

[041] As seen in Fig. 5, the generally coned formation of the platform together with the curvature of the conduit provide for a substantially un-obstructed line of the sight of the fundus of the eye to a surgeon treating the patient. The conduit accordingly assists in providing such a non-obstructed line of sight of the eye by initially slanting along its first section 201 in the posterior direction towards axis X

and then slants along its second section 202 in an opposite direction away from axis X.

[042] Attention is drawn to Fig. 6 illustrating the eyeball in isolation when securely fitted with the platform. Also seen in this view is a tip 99 of a surgical tool that advances out of the posterior tip section 77 of the conduit

[043] Figs. 7 to 10 illustrate a possible route of advancement of tip 99 of a primary tool while possibly employing transillumination technique for tracking the tip possibly via a microscope observing the fundus of the eye through the platform generally along axis X. In this example, the route of advancement may be towards a staphyloma (see indicated as 55 in Fig. 9) or any other treatment zone.

[044] As seen in Figs. 11 to 14, once the primary tool's tip arrives at a vicinity of the staphyloma, various procedures may take place. An additional secondary tool that may be advanced via the primary tool, may be used for various treatments, such as scleral crosslinking by juxta and or/intra-scleral injection of a drug or chemical (see, e.g. Fig. 13). Scleral crosslinking can be achieved either by utilizing UV light (see, e.g. Fig. 14) or directly by the Chemical/drug. Such intra-scleral injection may possibly be achieved by a secondary tool that includes inflatable microneedles at its tip (or the like).

[045] Fig. 15 illustrates an example of utilizing platform 10 for advancing a tool suitable for providing sub-retinal injection, and Fig. 16 illustrates an example of advancing via the conduit tool suitable for providing suprachoroidal injection.

[046] Figs. 17 to 19 demonstrate advancement of a fenestration instrument towards the optic nerve possibly again using transillumination technique for tracking the tip of the instrument, in order to possibly perform optic nerve sheath fenestration (see, e.g., Figs. 18, 19).

[047] Figs. 20 to 22 illustrate possibly advancement of drug delivery instruments via the platform, e.g. in order to perform drug injection adjacent the sclera for posterior scleritis (see Fig. 21), or for performing drug injection adjacent to the optic nerve for Neuritis/Neuropathy (see Fig. 21), or the like.

[048] Attention is drawn to Figs. 26 and 27 that schematically show an eyeball platform 1000 in accordance with an embodiment of the present invention. Platform 1000 has a framework 11 generally formed about a central axis X that defines opposing anterior and posterior axial directions. Platform 1000 as seen in addition
5 includes an introducing channel or conduit 20 (from hereon referred to as “conduit”), that extends between an anterior section 71 and a posterior tip section 77.

[049] Similar to the embodiment seen in Fig. 2, conduit 20 can be seen extending along a generally S curve that may be designed to have varying curvatures
10 in a non-deformed state. Conduit 20 may include a first section (see 201 in Fig. 2) that may be generally straight, which transitions in a posterior direction into a second section (see 202 in Fig. 2) that may be designed to have an increased curvature that extends away from axis X. A rate of change of the curvature of the second section may initially increase as it extends away from the first section in the
15 posterior direction and may then gradually decrease before possibly curving in an opposing direction.

[050] Platform 1000 may be defined as being of a ‘static’ type, in that it may be substantially devoid of any dedicated adjustment mechanism (such as e.g. 22 seen in Fig. 2) for biasing and/or adjusting the orientation of the conduit 20 in relation to the
20 framework 11. Platform 1000 can also be seen being provided with a support 21 that may be displaced from conduit upon the framework by about 180 degrees about axis X.

[051] A physician anchoring platform 1000 to a patient during surgery may grasp the platform with his fingers (e.g. the thumb and middle finger, or the like), by
25 placing them on the opposing structures of the conduit and support, in order to maneuver the platform towards its desired position on the eyeball.

[052] An anchored state of the platform may be assisted by vacuum attachment means located at a terminal ring member 14 of the platform and/or by any other suitable means such as pins that attach to the tissue of the eyeball (or the like). A

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suction nozzle 141 in communication with the ring member may be used for creating the vacuum required for attachment to the eye (in the case that vacuum is used for assisting in attachment to the eye).

[053] A possible anchoring sheath 18 (as seen e.g. in Figs. 1-5) may be located about an intermediate ring member 16 of platform 1000, while being attached to the intermediate ring member. Intermediate ring member 16 as seen in this example is axially spaced apart from ring member 14 in the anterior direction.

[054] In certain embodiments, once engaged with the eyeball, the anchoring sheath 18 possibly included in the platform may be suitably placed on surrounding facial regions, possibly adhered (e.g. self-adhered) to the skin of the patient by adhesive included upon sheath 18 and/or added to the sheath – to thus stabilize the platform in its anchored position with the aid of the skeletal orbital rim and/or facial bones.

[055] In the anchored state of the platform, the posterior tip section 77 of the conduit may be arranged to pass through an incision formed in the Tenon capsule to be situated below the Tenon capsule, which envelopes the eyeball. In this position, surgical tools introduced via the conduit towards a targeted treatment zone may be guided to advance below the Tenon capsule in order to reach regions of the eyeball such as retrobulbar regions of the eye, where therapeutic or surgical treatment is required. Platform 1000 can be seen in these figures being used for guiding a surgical tool 13 towards such a targeted treatment zone.

[056] It is noted that surgical tool embodiments being guided through any one of the eyeball platform embodiments described herein, may be suitably designed (e.g. provided with pre-defined curvatures along their extensions) to assist in their advancement towards retrobulbar regions of the eye, while maintaining their tips in proximity (possibly close abutment proximity) to the eye (e.g. proximity to the sclera of the eye).

[057] The interaction of the surgical tools with the Tenon capsule may assist in obtaining such proximity to the eye. In certain cases, certain surgical tool

embodiments may be equipped with guiding mechanisms for guiding the tip of the surgical tool in order to assist in obtaining such proximity to the eye, e.g. also when the tip is in retrobulbar regions of the eye. In certain cases, the proximity to the eye of guided or non-guided surgical tools may be of at least a tip region of the tool.

5 [058] Reverting back to Fig. 26 it can be seen that surgical tool 13 may be formed having a longitudinal extension L, which in cross sections perpendicular to axis L may have a lateral extension (Le) and a height extension (He). The lateral extension (Le) (similar to the surgical tool embodiments already described and shown hereinbefore) - may possibly be sized to be larger than the height extension
10 (He), for example about one and a half or twice larger (i.e. $Le \geq \sim 1.5$ or $\sim 2 \times He$). Such sizing of Le to relative He may be aimed at increasing the tool's moment of inertia so that the surgical tool may have improved resistance to twisting about its longitudinal extension L during use.

[059] In this example, the surgical tool 13 can be seen being advanced towards
15 the eye with one of its sides that extends along the lateral direction being oriented to bear against the interior of the eyeball (e.g. the sclera) while being advanced below the Tenon capsule towards a targeted treatment zone. Having the larger sized lateral extension Le in contact with the eyeball may further assist in stabilizing and controlling a desired orientation of the surgical tool 13 as it reaches its targeted
20 treatment zone, possibly at retrobulbar regions of the eye.

[060] In the shown example, the surgical tool 13 can be seen being formed from two tubes 131 that extend one aside the other along axis L – however other embodiments may be equally possible, such as surgical tools having generally rectangular, elliptical or other formations in their cross sections.

25 [061] Conduit 20 can be seen in this example (and also in former embodiments) as having an interior passage for the surgical tool that generally corresponds in cross section to the cross section of the surgical tool – in order to suitably guide the surgical tool towards its targeted treatment zone.

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[062] Also seen in the figures is that the surgical tool 13 may include a terminal port 1 at its distal leading side that is designed to lead it towards its targeted treatment zone as the tool is advanced along the eye below the Tenon capsule. In Fig. 27 the surgical tool 13 can be seen with its terminal port 1 reaching a targeted treatment zone, in this example at a retrobulbar region of the eye.

[063] Attention is drawn to Fig. 28 for a closer view of the tool's terminal port 1 when in position upon a targeted zone of the eyeball (with the Tenon capsule not being shown in this view). The terminal port 1 in this example can be seen being formed upon the distal axial end of the tool, and can be seen having a flat lower side 1a that is adapted to contact the interior of the eyeball (e.g. sclera) and a chamfered leading side 1b at its axial end that tapers towards its lower side 1a to meet it at a merge 1c.

[064] Surgical tool embodiments having such a chamfered leading side 1b may be suited to advance the surgical tool to its targeted treatment zone while assisting in maintaining the orientation of the terminal port 1 with its flat lower side 1a pressed against the eyeball - due to substantial constant engagement of the chamfered leading side 1b with the Tenon capsule it encounters as it advances towards its targeted position.

[065] Attention is drawn to Figs. 29 and 30 showing cross sectional views of the surgical tool's terminal port 1 taken along a plane generally parallel to axis L of the surgical tool. The terminal port 1 as seen in this example may include an optical member 1d. Optical member 1d may be suited to provide illumination and/or imaging of regions adjacent the terminal port of the surgical tool. In one non-binding example, the optical member 1d may be an LED however other options may also be possible such as a fiber optic assisted illumination and/or imaging (or the like). An optical member such as 1d may be used for assisting in the tracking of the surgical tools tip via a microscope, as seen in the examples shown e.g. in Figs. 7 to 10.

[066] Surgical tool 13 can also be seen in the example as including a movable hollow needle member 1e that can be seen in Figs. 29 and 30 being advanced to penetrate through a layer 62 of the eye in order to reach a targeted zone 61 that is beneath layer 62. In a non-binding example, layer 62 may be the sclera layer of the eye and targeted zone 61 may be the Suprachoroidal or subretinal spaces of the eye.

[067] The needle member can be seen being curved by a passage that leads it towards its distal exit point from the surgical tool, so that it is urged to extend along an axis T that is inclined relative to the surgical tool's axis L in this distal section of the tool. The needle member's tip can also be seen in this example having a relative small angle α that is formed between a chamfer or bevel 64 and an outer periphery 65 of the needle member. Such small angle α in some examples may be generally smaller than about 45 degrees and preferably smaller than about 25 or 15 degrees. A hollow passage 63 of the needle member opens out via the chamfer 63 at its tip.

[068] As seen in the enlarged section at the left hand side of Fig. 29, the distal tip of the needle member as it advances towards its targeted zone 61 in this example of the Suprachoroidal or subretinal spaces - initially exposes its sharpened edged tip towards the outer side of the sclera 62 in a position/orientation suitable to penetrate into the sclera.

[069] As seen in the enlarged section at the left hand side of Fig. 30, as the needle member advances along axis T within the sclera 62 towards the targeted zone 61, the chamfer of the tip reaches targeted zone 61 at a position where it is generally tangent to zone 61. In this position the needle member is suited to release drugs, devices, radioactive components, stem cells or gene carriers (or the like) - towards the targeted zone 61 with reduced likelihood of injecting unintentionally substances into other adjacent regions of the eye, such as the choroid, retina or into the vitreous cavity - since its sharp edge is now less positioned in an ideal orientation to penetrate into such adjacent regions other than the targeted zone.

[070] In the description and claims of the present application, each of the verbs, "comprise" "include" and "have", and conjugates thereof, are used to indicate that

the object or objects of the verb are not necessarily a complete listing of members, components, elements or parts of the subject or subjects of the verb.

[071] Further more, while the present application or technology has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and non-restrictive; the technology is thus not limited to the disclosed embodiments. Variations to the disclosed embodiments can be understood and effected by those skilled in the art and practicing the claimed technology, from a study of the drawings, the technology, and the appended claims.

[072] In the claims, the word “comprising” does not exclude other elements or steps, and the indefinite article “a” or “an” does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures can not be used to advantage.

[073] The present technology is also understood to encompass the exact terms, features, numerical values or ranges etc., if in here such terms, features, numerical values or ranges etc. are referred to in connection with terms such as “about, ca., substantially, generally, at least” etc. In other words, “about 3” shall also comprise “3” or “substantially perpendicular” shall also comprise “perpendicular”. Any reference signs in the claims should not be considered as limiting the scope.

[074] Although the present embodiments have been described to a certain degree of particularity, it should be understood that various alterations and modifications could be made without departing from the scope of the invention as hereinafter claimed.

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CLAIMS:

1. A platform for attaching to a human eyeball and having an axis defining opposing anterior and posterior axial directions, the platform comprising a framework formed about the axis, the framework comprising anterior and posterior
5 openings at respective anterior and posterior sides, and the platform comprises an at least partially curved hollow conduit that extends through the framework while passing through and/or opening at the anterior and posterior openings.
2. The platform of claim 1, wherein the framework being generally funnel
10 shaped, possibly cone shaped, tapering in the posterior direction.
3. The platform of claim 2, wherein the framework being arranged to enclose a space surrounding axis X to form a substantial unobstructed line of sight along axis X.
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4. The platform of claim 2, wherein the framework forms a skeletal structure substantially included in an imaginary surface that encloses a space surrounding axis X to form a substantial unobstructed line of sight along axis X.
- 20 5. The platform of claim 4, wherein the framework comprises at least two, possibly three, ring like members, wherein a first one of the ring like members defines the anterior opening and a second one of the ring like members defines the posterior opening.
- 25 6. The platform of claim 5, wherein the ring like member defining the posterior opening is arranged to contact the eyeball when the platform is attached to the eyeball.

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7. The platform of claim 1 and comprising an adjustment mechanism for adjusting the orientation of the conduit relative to the framework.

8. The platform of claim 7, wherein adjusting the orientation is along two axes,
5 preferably perpendicular to each other.

9. The platform of claim 4, wherein the curvature of the conduit is formed as it advances along the axis.

10 10. The platform of claim 9, wherein the conduit comprises a first generally straight section and a second generally curved section that extends away from the first section in a generally posterior direction.

11. The platform of claim 10, wherein the first section being arranged to protrude
15 and/or open in a generally anterior direction out of the framework via the anterior opening and the curved section being arranged to protrude and/or open in a generally posterior direction out of the framework via the posterior opening.

12. The platform of claim 11, wherein a rate of change of curvature of the second
20 section initially increases as it extends away from the first section in the posterior direction and then gradually decreases until possibly curving in an opposing direction.

13. The platform of claim 12, wherein the conduit comprises a tip at its posterior
25 end that is located at the posterior opening or beyond the posterior opening in the posterior direction.

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14. The platform of claim 13, wherein the tip of the conduit is arranged to be situated below the Tenon capsule in the subtenon space of an eyeball when the platform is fitted to an eyeball.

5 15. The platform of claim 6 and comprising an anchoring sheath that is fitted to the framework and extends about the framework.

16. The platform of claim 15, wherein the anchoring sheath is arranged to extend in a general lateral direction away from the axis of the platform as it extends about
10 the framework.

17. The platform of claim 16, wherein the anchoring sheath is fitted to an intermediate ring like member that is possibly located in between the first and second ring like members that respectively define the anterior and posterior
15 openings.

18. The platform of claim 17, wherein the intermediate ring like member is more proximal to the second ring like member.

20 19. The platform of claim 18, wherein an axial distance between the intermediate and second ring like members is adjustable.

20. The platform of any one of claims 19, wherein ring like members are generally parallel one to the other.

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21. A method for treating a retrobulbar region of an eye comprising the steps of:
providing a platform having an axis defining opposing anterior and posterior axial directions, the platform comprising a framework formed about the axis, the framework comprising anterior and posterior openings at respective anterior and

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posterior sides, and the platform comprises a hollow conduit that extends through the framework while passing through the anterior and posterior openings,

anchoring the platform to the eye so that possibly the platform's axis is generally aligned with the optical axis of the eye, and

5 advancing a surgical tool through the conduit towards a target position on the eye, possibly at a retrobulbar region of the eye.

22. The method of claim 21, and having the ability to tilt the conduit relative to the framework in order to control advancement of the tool towards the target position.

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23. The method of claim 22, wherein the tilting is about at least two axes, possible perpendicular one to the other.

24. The method of claim 21 and comprising a step of monitoring a position of a tip
15 of the surgical tool being introduced towards the target position.

25. The method of claim 24, wherein monitoring is by any one of: Light point based optical vision, Tissue indentation based optical vision, Tissue indentation based or juxtaposition of the treatment tool tip based by a scanning OCT or
20 Scanning UltraSound.

26. The method of claim 24, wherein the monitoring assists in the controlling of advancement of the tool towards the target position.

25 27. The method of claim 24, wherein the surgical tool comprises a terminal port at a distal leading side of the surgical tool that is designed to lead the surgical tool towards its targeted position as is advances along the eye below the Tenon capsule.

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28. The method of claim 27, wherein the terminal port comprising a flat lower side that is adapted to contact the interior of the eyeball and a chamfered leading side at its axial distal end that tapers in the distal direction towards its lower side to meet it at a merge.

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29. The method of claim 27 and comprising an optical module at the terminal port for assisting in monitoring the position of the terminal port as the surgical tool is advanced towards its target position.

10 30. The method of claim 27 and comprising a needle member that is movable to extend out of the terminal port via an exit point.

31. The method of claim 30, wherein the needle member being curved to extend out via the exit point along an axis T that is inclined relative to an axial extension L
15 of the surgical tool adjacent the exit point.

32. The method of claim 31, wherein a distal tip of the needle member comprises an internal relative small angle at its sharpened edged tip and a chamfer face adjacent the sharpened edged tip through which an internal passage of the needle member
20 opens out of the needle member, and wherein the internal relative small angle is smaller than about 45 degrees and preferably smaller than about 25 or 15 degrees.

33. The method of claim 32, wherein the distal tip of the needle member as it advances out of the exit point is arranged to penetrate into the eye towards an
25 internal target zone of the eye.

34. The method of claim 33, wherein the needle member prior to penetrating into the eye initially exposes its sharpened edged tip towards a generally outer layer of the eye in a position/orientation suitable to penetrate into the layer.

35. The method of claim 34, wherein as the needle member advances along its axis T through the eye and towards the targeted zone, the chamfer face of the needle member is adapted to reach the targeted zone at a position where it is generally
5 tangent to the targeted zone.

36. A platform for introducing various treatment tools through a conduit in order to treat various ocular pathologies by attaching it to a human eyeball, the platform having an axis defining opposing anterior and posterior axial directions and
10 comprising a framework formed about the axis, wherein the framework having anterior and posterior openings at respective anterior and posterior axial sides and the platform further comprising a hollow conduit that extends through the framework while passing through the anterior and posterior openings.

15 37. A platform for assisting in advancing surgical tools for treating an eye of a patient,

the platform having a central axis defining opposing anterior and posterior directions, and comprising:

a ring like attachment member suitable for attachment to an eyeball of the eye,
20 wherein the attachment member being formed about the central axis at a posterior side of the platform,

the platform further comprising a hollow conduit through which surgical tools can be advanced generally in the posterior direction, wherein

the conduit comprises a first generally straight section that tapers generally in
25 the posterior direction towards the central axis, and a second generally curved section that extends at least along a substantial initial portion thereof away from the first section and away from the central axis generally in the posterior direction.

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38. The platform of claim 37, wherein the second curved section is arranged to protrude and/or open in a generally posterior direction out of the platform at or via the attachment member.

5 39. The platform of claim 38, wherein a rate of change of curvature of the second curved section initially increases as it extends away from the first section in the general posterior direction and then gradually decreases until possibly curving in an opposing direction.

10 40. The platform of claim 39, wherein the conduit comprises a tip at its posterior end that is arranged to be situated below the Tenon capsule in the subtenon space of an eyeball when the platform is fitted to an eyeball.

15 41. The platform of claim 39 and comprising a framework formed about the central axis, the framework comprising anterior and posterior openings at respective anterior and posterior sides wherein the posterior opening comprises the attachment member, and the conduit extends through the framework while passing through or opening at the anterior and posterior openings.

20 42. The platform of claim 41, wherein the framework being generally funnel shaped, possibly cone shaped, tapering in the posterior direction.

25 43. The platform of claim 42, wherein the framework being arranged to enclose a space surrounding the central axis X to form a substantial unobstructed line of sight along the central axis X.

44. The platform of claim 42, wherein the framework forms a skeletal structure substantially included in an imaginary surface that encloses the space surrounding the central axis X.

45. The platform of claim 44, wherein the framework comprises at least two, possibly three, ring like members, wherein a first one of the ring like members defines the anterior opening and a second one of the ring like members is the attachment member at the posterior opening.

46. The platform of claim 41 and comprising an adjustment mechanism for adjusting the orientation of the conduit relative to the framework.

47. The platform of claim 46, wherein adjusting the orientation is along two axes, preferably perpendicular to each other.

48. The platform of claim 45 and comprising an anchoring sheath that is fitted to the framework and extends about the framework.

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49. A method for treating a retrobulbar region of an eye comprising the steps of:

providing a platform having a central axis defining opposing anterior and posterior directions, and comprising: a ring like attachment member suitable for attachment to an eyeball of the eye, wherein the attachment member being formed about the central axis at a posterior side of the platform, the platform further comprising a hollow conduit through which surgical tools can be advanced generally in the posterior direction, wherein the conduit comprises a first generally straight section that tapers generally in the posterior direction towards the central axis, and a second generally curved section that extends at least along a substantial initial portion thereof away from the first section and away from the central axis generally in the posterior direction,

anchoring the platform via the ring like attachment member to the eye so that possibly the platform's axis is generally aligned with the optical axis of the eye, and

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advancing a surgical tool through the conduit towards a target position on the eye, possibly at a retrobulbar region of the eye.

5 **50.** The method of claim 49, and having the ability to tilt the conduit relative to the framework in order to control advancement of the tool towards the target position.

51. The method of claim 50, wherein the tilting is about at least two axes, possible perpendicular one to the other.

10 **52.** The method of claim 49 and comprising a step of monitoring a position of a tip of the surgical tool being introduced towards the target position.

15 **53.** The method of claim 52, wherein monitoring is by any one of: Light point based optical vision, Tissue indentation based optical vision, Tissue indentation based or juxtaposition of the treatment tool tip based by a scanning OCT or Scanning UltraSound.

54. The method of claim 53, wherein the monitoring assists in the controlling of advancement of the tool towards the target position.

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55. The method of claim 49, wherein the surgical tool comprises a terminal port at a distal leading side of the surgical tool that is designed to lead the surgical tool towards its targeted position as is advances along the eye below the Tenon capsule.