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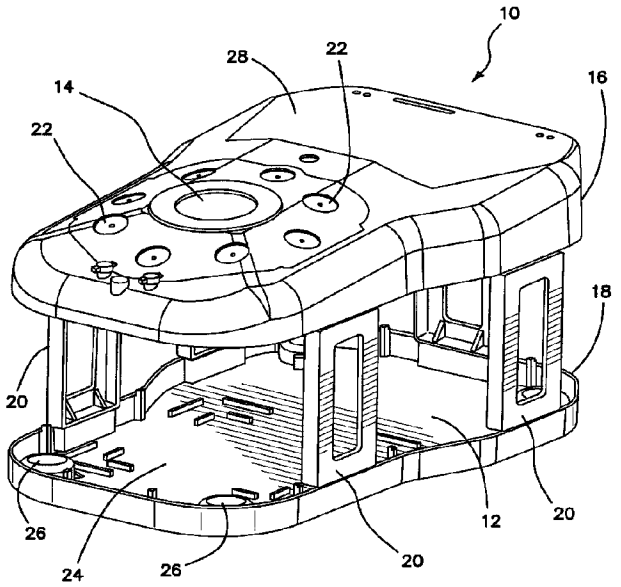
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(54) Title: SURGICAL TRAINING MODEL FOR LAPAROSCOPIC PROCEDURES



(57) Abrégé/Abstract:
A surgical training device is provided. The training device includes a practice model comprising a base with a plurality of eyelets connected to the outer surface of the base. The plurality of eyelets defines at least one predetermined pathway for practicing the passing of at least one needle and suture through the eyelets of the predetermined pathway. Various eyelets are described including angled, flexible, deflectable, interchangeable, retractable, rotatable and ones having apertures of various shapes and sizes. The predetermined pathway is marked with markings on the outer surface of base or with color-coded eyelets. Suture pathways define anatomical pathways as well as differing skill levels. The model provides a platform for practicing hand-to-hand transfer and depth perception among other skills required in laparoscopic procedures.

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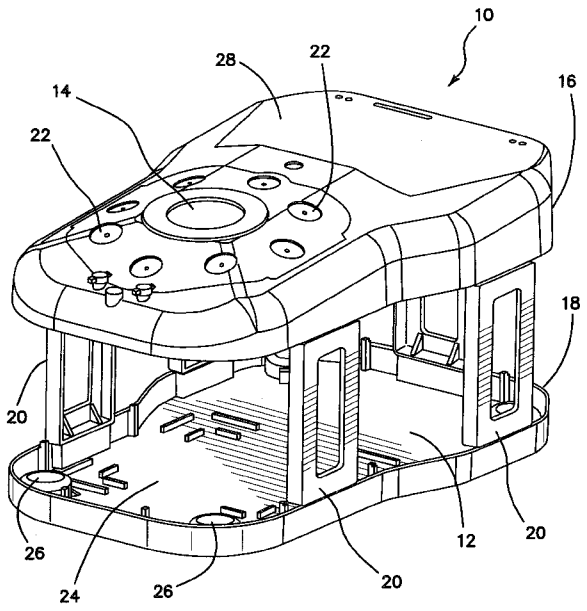


FIG. 1

(57) Abstract: A surgical training device is provided. The training device includes a practice model comprising a base with a plurality of eyelets connected to the outer surface of the base. The plurality of eyelets defines at least one predetermined pathway for practicing the passing of at least one needle and suture through the eyelets of the predetermined pathway. Various eyelets are described including angled, flexible, deflectable, interchangeable, retractable, rotatable and ones having apertures of various shapes and sizes. The predetermined pathway is marked with markings on the outer surface of base or with color-coded eyelets. Suture pathways define anatomical pathways as well as differing skill levels. The model provides a platform for practicing hand-to-hand transfer and depth perception among other skills required in laparoscopic procedures.

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SURGICAL TRAINING MODEL FOR LAPAROSCOPIC PROCEDURES

[0001]

FIELD OF THE INVENTION

[0002] This application is generally related to surgical training tools, and in particular, to simulated tissue structures and models for teaching and practicing various surgical techniques and procedures related but not limited to laparoscopic, endoscopic and minimally invasive surgery.

BACKGROUND OF THE INVENTION

[0003] Medical students as well as experienced doctors learning new surgical techniques must undergo extensive training before they are qualified to perform surgery on human patients. The training must teach proper techniques employing various medical devices for cutting, penetrating, clamping, grasping, stapling, cauterizing and suturing a variety of tissue types. The range of possibilities that a trainee may encounter is great. For example, different organs and patient anatomies and diseases are presented. The thickness and consistency of the various tissue layers will also vary from one part of the body to the next and from one patient to another. Different procedures demand different skills. Furthermore, the trainee must practice techniques in various anatomical environs that are influenced by factors such as the size and condition of the patient, the adjacent anatomical landscape and the types of targeted tissues and whether they are readily accessible or relatively inaccessible.

[0004] Numerous teaching aids, trainers, simulators and model organs are available for one or more aspects of surgical training. However, there is a need for models or simulated tissue elements that are likely to be encountered in and that can be

used for practicing endoscopic and laparoscopic, minimally invasive surgical procedures. In laparoscopic surgery, a trocar or cannula is inserted to access a body cavity and to create a channel for the insertion of a camera such as a laparoscope. The camera provides a live video feed capturing images that are then displayed to the surgeon on one or more monitors. At least one additional small incision is made through which another trocar/cannula is inserted to create a pathway through which surgical instruments can be passed for performing procedures observed on the monitor. The targeted tissue location such as the abdomen is typically enlarged by delivering carbon dioxide gas to insufflate the body cavity and create a working space large enough to accommodate the scope and instruments used by the surgeon. The insufflation pressure in the tissue cavity is maintained by using specialized trocars. Laparascopic surgery offers a number of advantages when compared with an open procedure. These advantages include reduced pain, reduced blood and shorter recovery times due to smaller incisions.

[0005] Laparoscopic or endoscopic minimally invasive surgery requires an increased level of skill compared to open surgery because the target tissue is not directly observed by the clinician. The target tissue is observed on monitors displaying a portion of the surgical site that is accessed through a small opening. Therefore, clinicians need to practice visually determining tissue planes, three-dimensional depth perception on a two-dimensional viewing screen, hand-to-hand transfer of instruments, suturing, precision cutting and tissue and instrument manipulation. Typically, models simulating a particular anatomy or procedure are placed in a simulated pelvic trainer where the anatomical model is obscured from direct visualization by the practitioner. Ports in the trainer are employed for passing instruments to practice techniques on the anatomical model hidden from direct visualization. Simulated pelvic trainers provide a functional, inexpensive and practical means to train surgeons and residents the basic skills and typical techniques used in laparoscopic surgery such as grasping, manipulating, cutting, tying knots, suturing, stapling, cauterizing as well as how to perform specific surgical procedures that utilized these basic skills. Simluated pelvic trainers are also effective sales tools for demonstrating medical devices required to perform these laparoscopic procedures.

[0006] One of the techniques mentioned above that requires practice in endoscopic or laparoscopic minimally invasive surgery is the passing of sutures and suturing which requires the clinician to develop skills such as three-dimensional depth perception and hand-to-hand transfer of a needle and suture while the target tissue and instruments are observed on a two-dimensional video monitor. Therefore, it is desirable to present a model suitable for practicing suturing and, in particular, there is a need for a model that isolates a particular step of a procedure for the trainee such as the passing of sutures for the clinician to practice in a simulated laparoscopic environment. The laparoscopic training model is removably placed inside a simulated laparoscopic environment such as a laparoscopic trainer in which it is at least partially obscured from direct visualization. A camera and monitor provide visualization to the practitioner. After a technique is practiced, it is furthermore desirable that such a model permits repeatable practice with ease, speed and cost savings. In view of the above, it is an object of this invention to provide a surgical training device that realistically simulates an anatomy and isolates a particular stage or step of a procedure that also enables repeatable practice. It has been demonstrated that the use of simulation trainers greatly enhances the skill levels of new laparoscopists and are a great tool to train future surgeons in a non-surgical setting. There is a need for such improved, realistic and effective surgical training models.

SUMMARY OF THE INVENTION

[0007] According to one aspect of the invention, a surgical training device is provided. The device includes a top cover spaced apart from a base to define an internal cavity between the top cover and the base. At least one aperture or a penetrable region for accessing the internal cavity is provided and a laparoscopic camera is disposed inside the cavity and configured to display video images on a video monitor connected to the camera and located outside of the cavity. A model is removably disposed inside the cavity such that the model is substantially obscured from a user yet observable via the laparoscopic camera displaying video images of the model on the video monitor. The model includes a base having an outer surface and a plurality of eyelets connected to the base. The plurality of eyelets are configured along

the surface to define a pathway for practicing the passing of at least one needle and suture through one or more of the plurality of eyelets of the pathway.

[0008] According to another aspect of the invention, a surgical training device is provided. The device includes a base having an outer surface and a plurality of eyelets connected to the outer surface of the base. Each eyelet has a head portion connected to a neck portion. The neck portion is connected to the base at a proximal end of the eyelet. The head portion includes an aperture defining an aperture plane having a first side and a second side. The plurality of eyelets are configured with respect to the base such that at least one aperture plane is angled with respect to at least one other aperture plane of the plurality of eyelets. At least a subset of the plurality of eyelets defines a pathway with apertures that are sized for passing a suture and suture needle.

[0009] According to another aspect of the invention, a method for practicing laparoscopic suture passing is provided. The method includes providing a device having a base with an outer surface and a plurality of eyelets connected to the base. Each eyelet has a head portion connected to a neck portion. The neck portion is connected to the base. The plurality of eyelets includes at least one retractable eyelet. The retractable eyelet is retractable with respect to the outer surface such that the retractable eyelet has a first position in which the aperture is at a first distance relative to the outer surface and a second position in which the aperture is at a second distance relative to the outer surface. The second distance is greater above the outer surface than the first distance. The method includes grasping a retractable eyelet and pulling it from a first position to a second position. The eyelet is held in the second position while a suture and needle are passed through the aperture. The method includes releasing the retracted eyelet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 illustrates a top perspective view of a surgical training device according to the present invention.

[0011] FIG. 2 illustrates a top perspective view of a model according to the present invention.

[0012] FIG. 3 illustrates a top perspective view of a model according to the present invention.

[0013] FIGs. 4A-4D illustrate various eyelets according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] A surgical training device 10 that is configured to mimic the torso of a patient such as the abdominal region is shown in FIG. 1. The surgical training device 10 provides a body cavity 12 substantially obscured from the user for receiving simulated or live tissue or model organs or training models of the like described in this invention. The body cavity 12 is accessed via a tissue simulation region 14 that is penetrated by the user employing devices to practice surgical techniques on the tissue or practice model found located in the body cavity 12. Although the body cavity 12 is shown to be accessible through a tissue simulation region, a hand-assisted access device or single-site port device may be alternatively employed to access the body cavity 12. An exemplary surgical training device is described in U.S. Patent Application Serial No. 13/248,449 entitled "Portable Laparoscopic Trainer" filed on September 29, 2011. The surgical training device 10 is particularly well suited for practicing laparoscopic or other minimally invasive surgical procedures.

[0015] Still referencing FIG. 1, the surgical training device 10 includes a top cover 16 connected to and spaced apart from a base 18 by at least one leg 20. FIG. 1 shows a plurality of legs 20. The surgical training device 10 is configured to mimic the torso of a patient such as the abdominal region. The top cover 16 is representative of the anterior surface of the patient and the space 12 between the top cover 16 and the base 18 is representative of an interior of the patient or body cavity where organs reside. The surgical trainer 10 is a useful tool for teaching, practicing and demonstrating various surgical procedures and their related instruments in simulation of a patient undergoing a surgical procedure. Surgical instruments are inserted into the cavity 12 through the tissue simulation region 14 as well as through pre-established apertures 22 in the top cover 16. Various tools and techniques may be used to

penetrate the top cover 16 to perform mock procedures on simulated organs or practice models placed between the top cover 16 and the base 18. The base 18 includes a model-receiving area 24 or tray for staging or holding a simulated tissue model or live tissue. The model-receiving area 24 of the base 18 includes frame-like elements for holding the model (not shown) in place. To help retain a simulated tissue model or live organs on the base 18, a clip attached to a retractable wire is provided at locations 26. The retractable wire is extended and then clipped to hold the tissue model in position substantially beneath the tissue simulation region 14. Other means for retaining the tissue model include a patch of hook-and-loop type fastening material (VELCRO®) affixed to the base 18 in the model receiving area 24 such that it is removably connectable to a complementary piece of hook-and-loop type fastening material (VELCRO®) affixed to the model.

[0016] A video display monitor 28 that is hinged to the top cover 16 is shown in a closed orientation in FIG. 1. The video monitor 62 is connectable to a variety of visual systems for delivering an image to the monitor. For example, a laparoscope inserted through one of the pre-established apertures 22 or a webcam located in the cavity and used to observe the simulated procedure can be connected to the video monitor 28 and/or a mobile computing device to provide an image to the user. Also, audio recording or delivery means may also be provided and integrated with the trainer 10 to provide audio and visual capabilities. Means for connecting a portable memory storage device such as a flash drive, smart phone, digital audio or video player, or other digital mobile device is also provided, to record training procedures and/or play back pre-recorded videos on the monitor for demonstration purposes. Of course, connection means for providing an audio visual output to a screen larger than the monitor is provided. In another variation, the top cover 10 does not include a video display but includes means for connecting with a laptop computer, a mobile digital device or tablet such as an IPAD® and connecting it by wire or wirelessly to the trainer.

[0017] When assembled, the top cover 16 is positioned directly above the base 18 with the legs 20 located substantially around the periphery and interconnected between the top cover 16 and base 18. The top cover 16 and base 18 are substantially the same shape and size and have substantially the same peripheral outline. The

internal cavity is partially or entirely obscured from view. In the variation shown in FIG. 1, the legs include openings to allow ambient light to illuminate the internal cavity as much as possible and also to advantageously provide as much weight reduction as possible for convenient portability. The top cover 16 is removable from the legs 20 which in turn are removable or collapsible via hinges or the like with respect to the base 18. Therefore, the unassembled trainer 10 has a reduced height that makes for easier portability. In essence, the surgical trainer 10 provides a simulated body cavity 12 that is obscured from the user. The body cavity 12 is configured to receive at least one surgical model accessible via at least one tissue simulation region 14 and/or apertures 22 in the top cover 16 through which the user may access the models to practice laparoscopic or endoscopic minimally invasive surgical techniques.

[0018] A model 30 for the practice of passing sutures in laparoscopic procedures according to the present invention is shown in FIG. 2. The model 30 is configured to be placed inside the surgical training device 10 described above or other similar surgical trainer. The model 30 includes a base 32, and a plurality of eyelets 34 connected to the surface of the base 32.

[0019] The base 32 of the model 30 is a platform that serves as a bottom support for the rest of the model 30 and it is sized and configured such that the model does not tip over. The platform is made of any material such as metal or plastic. The base 32 is of sufficient heft to maintain the stability of the model 30 in the upright position while being manipulated by a user. The model 30 is sized and configured to be placed into the body cavity 12 of the surgical trainer 10 in the location of the model receiving area 24. The underside of the base 32 is provided with means to affix the model 30 inside the surgical trainer 10. Such means to affix the model 30 inside the trainer 10 include but are not limited to adhesive, suction cup, magnet, snap-fit, and a hook-and-loop type fastener material attached to the bottom surface of the base 32 and configured to connect with a complementary hook-and-loop type fastener material or adhesive attached to the base 18 of the surgical trainer 30.

[0020] The base 32 of the model 30 includes an outer surface 36 which may be flat or contoured in various ways. For example, the outer surface can be convex as shown in FIG. 2. The outer surface 36 may be concave, curved, sloped, undulating or

otherwise have any configuration or geography including an upward hill, a downward hill, valleys and peaks including smaller surface additions such bumps or divots that compliment the larger features. The geography of the outer surface 36 creates a varying surface or numerous planes to permit the user to practice depth perception in laparoscopic surgery. In one variation, the base 32 is not rigid and solid but is pliable, resilient and flexible, and deflectable when manipulated with surgical instruments that would be used in laparoscopic surgery. As such, the base 32 is made of pliable, resilient material such as rubber or silicone. Another example of the geography of the outer surface 36 of the base 32 is shown in FIG. 3. The model 30 in FIGs. 2 and 3 is shown positioned with the operative outer surface 36 facing upwardly. However, the model 30 may be positioned on its side in the trainer 10 to provide another variation and representation of internal bodily structures for practicing laparoscopic procedures. In this alternative orientation, the side surface of the model 30 is provided with eyelets 34.

[0021] The model 30 includes a plurality of eyelets or apertures 34 connected to the base 32 such that the eyelets 34 are configured to reside above the outer surface 36 or side surface of the model 30 as shown in FIGs. 2 and 3. An exemplary eyelet 34 is shown in FIG. 4A. In general, the eyelet 34 is configured to provide an opening through which a clinician can practice passing a needle and suture. The eyelet 34 includes a neck portion 38 and a head portion 40. The head portion 40 includes at least one aperture 42 defining an aperture plane in which it lies. Although the aperture 42 is shown to have a circular shape, the invention is not so limited and the aperture 42 can have any shape such as a polygon or closed curve. While FIG. 4A depicts a closed aperture 42, an open aperture 44 is within the scope of the present invention as shown in FIG. 4B. An open or hook-like aperture 44 is an aperture that is open and only partially enclosed by surrounding material of the head portion 40 leaving an opening or entry into the aperture 40 that is anywhere from approximately 1/8 to 1/4 of the aperture perimeter in size. In one variation, the aperture 42 of the eyelet 34 is covered with a layer of silicone or other penetrable material that may include a mesh or fabric reinforcement such that passing a needle and suture through the aperture 42 requires piercing the covering of the aperture 42 with the needle and suture. The covering mimics real tissue and thus contributes to the realism of the exercise.

[0022] In one variation, the eyelet 34 is rigid. In another variation, the neck portion 38 of the eyelet 34 is flexible while the head portion 40 is rigid and in another variation both the neck portion 38 and head portion 40 are flexible or capable of being deflected. A deflectable or flexible eyelet 34 increases the difficult of performing suture passing. In another variation, the eyelet 34 is pre-bent or angled. The plane defined by the aperture intersects with the longitudinal axis of the neck portion 38 as shown in FIGs. 4C and 4D. In general, the eyelet 34 provides an aperture 42 for the surgeon to practice passing a needle and suture through. The neck 38 of the eyelet 34 is configured to space the aperture 42 from the outer surface 36 of the base 32. Other means for spacing the aperture 42 from the outer surface 36 of the base 32 are within the scope of the present invention. Also, the neck 38 is configured to connect to the base 32 and as such, the neck 38 may include threads, adhesive or other means for connection to the base. Also, the eyelet 34 may be mounted to the base 32 such that the entire eyelet 34 rotates or is rotatable with respect to the base 32 and, in another variation, the eyelet 34 is configured such that the head 40 of the eyelet 34 rotates with respect to the neck portion 38 in a free-spinning eyelet configuration. Such resulting rotatability of the aperture 42 with respect to the base 32 increases the difficulty of passing sutures.

[0023] A plurality of eyelets 34 are connected to the outer surface 36 of the base 32 as shown in FIGs. 2 and 3. In another variation, one or more eyelets 34 is retractable with respect to the outer surface 36 such that the retractable eyelet 34 has a first position in which the aperture 42 of the eyelet 34 is at a first distance relative to the outer surface 36 and a second position in which the aperture 42 is at a second distance relative to the outer surface 36 wherein the second distance is greater above the outer surface 36 than the first distance. In one variation, the eyelet 34 is biased towards the first position such that the eyelet 34 has a tendency to spring back toward the first position. Furthermore, at least one eyelet 34 is connected to the base 32 such that at least a portion of the eyelet 34, such as at least a portion of the aperture 42 of the eyelet 36, is beneath the upper surface 36 so that the eyelet 34 is visible to user but, in order to pass a suture through the eyelet 34, the eyelet 34 laying partially beneath the surface is pulled-up or extracted by the user and held with one instrument in the extracted

position so that the suture needle and suture may be passed through the aperture 42 of the eyelet 34 with another instrument held in the opposite hand. When released from the extracted position, the eyelet 34 would retract back to its at least partial sub-surface position. The retractable eyelet 34 is embedded in an elastic base different from the upper surface 36 or spring biased with respect to the upper surface 36. Also, the retractable eyelet 34 is biased in the retracted position such that force is required to pull the eyelet above surface and hold it in position above the upper surface 36 for suture passing. When released, the eyelet 34 would be pulled back toward beneath the surface. In another variation, the retractable eyelets 34 are not biased inwardly but move in and out between a first position and a second above-surface position wherein the first position may be at least partially beneath the surface. The eyelets 34 would be slotted to move within a slot axially relative to the upper surface 36. Each eyelet 34 may be the same or the plurality of eyelets 34 may include a mixture of eyelets 34 having different features described above such as eyelets with apertures 42 of different sizes and shapes, flexible eyelets, rotatable eyelets, covered eyelets, open eyelets, deflectable eyelets, retractable eyelets, plastically deformable eyelets which when deflected remain deflected and deflectable eyelets that resume their previous position after being deflected. The plurality of eyelets 34 may include eyelets of different colors including colors that blend in against the background or color of the outer surface 36 of the base 32 for increased difficulty in visualizing the eyelet aperture 42 on a camera viewing monitor. Also, at least one of the eyelets 34 attached to the base 32 may also be colored such that the eyelet 34 visually stands out or is in contrast when viewed against the background or outer surface 36 of the base with a laparoscope. Furthermore, the plurality of eyelets 34 may include one or more groups of eyelets that have the same color, thus being color-coded so that a predetermined path along which a suture must be passed is defined by the color of the eyelets 34. For example, a set of green-colored eyelets 34 may define either a predetermined path that is particular to a surgical procedure or may define a relatively easy skill level defined by eyelets 34 with relatively large apertures 42, for example. Alternatively, the predetermined path may be marked not with the coloring of the eyelets 34 but with markings 46 on the outer surface 36 of the base 32 as shown in FIG. 2. Such markings 46 on the outer surface 36 can

include anatomical landmarks from which the user can deduct the correct pathway to follow for passing sutures. Alternatively, the markings 46 are lines drawn on the outer surface 36 between eyelets 34 interconnecting them to define the predetermined path. The line 46 is contrast colored against the base 32 as in FIG. 2 and may be color-coded to indicate a particular predetermined pathway. Also, among the plurality of eyelets 34 attached to the base 32, groups of eyelets 34 may be interconnected with markings 46 such as lines drawn on the base 32 that connect the eyelets 34 within a certain group. The certain group of eyelets can define a predetermined pathway to follow for testing the skill of the user making sure that all eyelets 34 of a particular group lying along a particular pathway have been passed through with a suture. Hence, the arrangement and choice of eyelets 34 in a subset of eyelets 34 among a plurality attached to the base, can be used to improve the skill of passing a needle and suture through an aperture and as such the pathways and eyelets selected in each pathway can vary in difficulty from relatively easy eyelets, for example, ones having large apertures, standing upright, being rigid or located in relatively flat areas of the outer surface and being starkly contrasted against the background to more difficult eyelets, for example ones comprising smaller apertures, flexible eyelets, deflectable eyelets so eyelets colored so as to blend in with the background. The base 32 may be sold as part of a kit with a plurality of different types of eyelets 34 described above which the user would then assemble by selecting from the plurality of different eyelets and then placing them as desired into the base 32 to form a custom pathway for practice. The eyelets 34 and base 32 are configured such that the eyelets 34 can be pushed through the outer surface 36 of the base 32 to securely attach the eyelets 34. The kit may also include organs or other anatomical features that can also be connected to the base to create an anatomy suitable for a particular practice.

[0024] A predetermined pathway for passing sutures may be predefined based on the surgical procedure to be practiced. For example, the practice of closing the vaginal vault may require a generally circular pathway at a particular angle with eyelets having small apertures. Accordingly, such a pathway may be defined and marked by eyelets of the same color or markings on the base for the surgeon to follow. Another surgical procedure such as anastomosis of a bowel may require a larger

generally circular pathway of closely spaced pairs of eyelets. Hence, the surgical procedure to be practiced may determine the types of eyelets used and their arrangement and the markings indicating that particular pathway to the user.

[0025] The eyelets 34 are embedded within the base in a variety of patterns and configurations creating patterns and pathways. Some pathways may be aimed at making sure the clinician visualizes all the eyelets and successfully passes through all within a set without missing ones that are difficult to visualize or to pass a suture through. Of course, the eyelets are placed at differing heights and angles with the objective being for the surgeon to pass an actual suture needle or simulated suture needle through each eyelet and in a specific order to complete each pathway. There are multiple pathways with different sized eyelets for different skill levels which allows for skill advancement within the same platform. The practice model 30 is placed inside a laparoscopic trainer 10 and a laparoscope is inserted into the cavity 12 to observe the model 30. A suture needle and suture are passed through one of the apertures 22 or tissue simulation region 14 into the cavity 12 and the procedure of passing the suture through the eyelets 34 is observed on the video display monitor 28 providing a two-dimensional video representation to the practitioner of the three-dimensional model 30 inside the laparoscopic trainer 10 and obscured from direct visualization. The model 30 and trainer 10 combination advantageously allow the user to practice identifying a desired surgical pathway for the suture, moving the needle and passing the suture through a number of eyelets 34 laparoscopically.

[0026] The model 30 may include interchangeable eyelets 34 in which the user may personally select certain eyelets or select a predetermined set of eyelets that corresponds to a pathway of a surgical procedure for practicing certain skills, difficulty levels or procedures. The model 30 is advantageously challenging and adjustable for all skill levels and effective in that the user must use both hands equally to complete the path. The suture needle must also be manipulated to be facing the proper direction for each pass in order to successfully pass it through the aperture. Hence, the model is particularly useful for the practice of laparoscopic suture passing, determining and visualizing tissue planes, the practice of depth perception and visualization of eyelets, hand-to-hand transfer of instruments and needles, suturing and tissue manipulation.

This model allows clinicians to keep their skills sharp or to "warm-up" beforehand for successful outcomes in real surgery.

[0027] While certain embodiments have been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope thereof as defined by the following claims.

CLAIMS:

1. A surgical training device, comprising:

a device base;

a top cover spaced apart from the device base to define an internal cavity between the top cover and the device base;

at least one aperture or a penetrable region for accessing the internal cavity;

a laparoscopic camera disposed inside the internal cavity and configured to display video images on a video monitor connected to the camera and located outside of the internal cavity; and

a model removably disposed inside the internal cavity such that the model is substantially obscured from a user yet observable via the laparoscopic camera displaying video images of the model on the video monitor; the model comprising a model base having an outer surface and a plurality of removable eyelets that are detachably connected to the model base; wherein a subset of the plurality of removable eyelets are customizable along the outer surface to define a custom pathway for practicing the passing of at least one needle and suture through one or more of the plurality of removable eyelets of the custom pathway, and wherein at least one eyelet of the plurality of removable eyelets positioned above the outer surface is retractable to a different position below the outer surface, the at least one eyelet biased towards the position below the outer surface.

2. The surgical training device of claim 1, wherein the plurality of removable eyelets are spaced above the outer surface of the model base.

3. The surgical training device of claim 1, wherein the plurality of removable eyelets includes a neck portion and a head portion; the head portion defining an aperture sized and configured for the passage of a needle and suture and the neck portion being configured to connect to the model base.

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4. The surgical training device of claim 3, wherein the neck portion is angled with respect to the head portion.

5. The surgical training device of claim 3, wherein the head portion of the eyelet is covered with a layer of a penetrable material such that passing of the at least one needle and suture requires piercing of the layer with the at least one needle.

6. The surgical training device of claim 1, wherein at least one of the plurality of removable eyelets is interchangeable.

7. The surgical training device of claim 1, wherein at least one of the plurality of removable eyelets is angled with respect to the model base.

8. The surgical training device of claim 1, wherein at least one of the plurality of removable eyelets is rotatable with respect to the model base.

9. The surgical training device of claim 1, wherein the at least one of the plurality of removable eyelets has the head portion that is rotatable with respect to the neck portion in a free-spinning configuration.

10. The surgical training device of claim 1, wherein the pathway is a predetermined pathway defined by the subset of the plurality of removable eyelets having the same color.

11. The surgical training device of claim 10, wherein the subset of the plurality of removable eyelets corresponding to the pre-determined pathway is based on a surgical procedure, and wherein a different subset of the plurality of removable eyelets are used for different surgical procedures.

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12. The surgical training device of claim 1, wherein the pathway is a predetermined pathway defined by markings on the outer surface of the model base.

13. The surgical training device of claim 1, wherein the outer surface of the model base is concave or convex.

14. The surgical training device of claim 1, wherein the outer surface of the model base is curved.

15. The surgical training device of claim 1, wherein the plurality of removable eyelets are deflectable by contact with a suture needle.

16. The surgical training device of claim 1, wherein the model base is pliable such that force exerted on one or more of the plurality of removable eyelets flexes the outer surface of the model base.

17. The surgical training device of claim 1, wherein the pathway is predetermined to define a suture pathway shape encountered in real surgery.

18. The surgical training device of claim 1, wherein the pathway is predetermined to define a suture pathway shape associated with a human organ.

19. The surgical training device of claim 1, wherein the pathway is predetermined to define a predetermined skill level for passing sutures laparoscopically.

20. The surgical training device of claim 1, wherein the at least one aperture is configured to allow one or more surgical instruments to access the internal cavity through the top cover of the surgical training device.

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21. The surgical training device of claim 1, further comprising an external computer, wherein the external computing device is also connected to the laparoscopic camera and displays the video images captured by the laparoscopic camera.

22. The surgical training device of claim 1, wherein the top cover is held in place with respect to the device base via a plurality of legs.

23. The surgical training device of claim 22, wherein the top cover is removable.

24. The surgical training device of claim 22, wherein the plurality of legs are removable.

25. The surgical training device of claim 22, wherein the plurality of legs are collapsible.

26. The surgical training device of claim 1, wherein the model base is affixed to the device base using one or more connective elements.

27. A surgical training device comprising:

a base having an outer surface; and

a plurality of removable eyelets connected to the base; each of the plurality of removable eyelets having a head portion at a distal end connected to a neck portion; the neck portion is connected to the base at a proximal end of each of the plurality of removable eyelets; the head portion having an aperture defining an aperture plane having a first side and a second side;

wherein the plurality of removable eyelets are configured with respect to the base such that at least one aperture plane is angled with respect to at least one other aperture plane of the plurality of removable eyelets; wherein at least a subset of the plurality of removable eyelets defines a pathway with apertures that are sized for passing a suture and suture needle, wherein at least one eyelet of the plurality of removable eyelets is retractable with respect to the outer surface such that the retractable eyelet has a first position in which the aperture is at a first distance relative to the outer surface and a second position in which the aperture is at a second

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distance relative to the outer surface, wherein the second distance is greater above the outer surface than the first distance, and wherein the at least one retractable eyelet is biased towards the first position.

28. The surgical training device of claim 27, wherein the pathway is a predetermined pathway marked by a line drawn on the outer surface of the base.

29. The surgical training device of claim 27, wherein the pathway is a predetermined pathway comprising the subset of the plurality or removable eyelets having the same color.

30. The surgical training device of claim 27, wherein the at least one aperture plane rotates with respect to at least one other aperture plane of the plurality of removable eyelets.

31. The surgical training device of claim 27, wherein at least one aperture of the plurality of removable eyelets is covered with silicone.

32. The surgical training device of claim 27, wherein the pathway is a predetermined pathway that approximates a suture pathway encountered in laparoscopic surgery.

33. The surgical training device of claim 27, wherein the at least one retractable eyelet that is biased towards the first position has a tendency to spring back towards the first position when moved away from the first position.

34. The surgical training device of claim 27, wherein the first position is characterized by the aperture of the at least one retractable eyelet being at least partially beneath the outer surface.

35. The surgical training device of claim 34, wherein the at least one retractable eyelet that is partially beneath the outer surface is extracted to and held at a second position above the outer surface.

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36. The surgical training device of claim 35, wherein the at least one retractable eyelet retracts partially beneath the outer surface when released.

37. The surgical training device of claim 27, wherein at least one of the plurality of removable eyelets is flexible.

38. A surgical training device comprising:

a base having an outer surface; and

a plurality of movable eyelets connected to the base, each of the plurality of movable eyelets having a head portion at a distal end connected to a neck portion, the neck portion is connected to the base at a proximal end of each of the plurality of movable eyelets, and the head portion having an aperture defining an aperture plane having a first side and a second side,

wherein the plurality of movable eyelets are configured with respect to the base such that at least one aperture is angled with respect to at least one other aperture plane of the plurality of movable eyelets, wherein at least a subset of the plurality of movable eyelets defines a pathway with apertures that are sized for passing a suture and suture needle, wherein at least one eyelet of the plurality of movable eyelets positioned above the outer surface is retractable to a different position below the outer surface, and wherein the at least one eyelet is biased towards the position below the outer surface.

39. A surgical training device, comprising:

a device base;

a top cover spaced apart from the device base to define an internal cavity between the top cover and the device base;

at least one aperture or a penetrable region for accessing the internal cavity;

a laparoscopic camera disposed inside the internal cavity and configured to display video images on a video monitor connected to the camera and located outside of the internal cavity; and

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a model removably disposed inside the internal cavity such that the model is substantially obscured from a user yet observable via the laparoscopic camera displaying video images of the model on the video monitor, the model comprising a model base having an outer surface and a plurality of movable eyelets that are connected to the model base, wherein at least one of the plurality of movable eyelets positioned above the outer surface is retractable to a different position below the outer surface, wherein the at least one of the plurality of movable eyelets is biased towards the position below the outer surface, and wherein the plurality of movable eyelets are customizable along the outer surface to define a custom pathway for practicing the passing of at least one needle and suture through one or more of the plurality of movable eyelets of the custom pathway.

40. The surgical training device of claim 38 or 39, wherein the plurality of movable eyelets have the head portion rotates with respect to the neck portion in a free-spinning eyelet configuration.

41. The surgical training device of claim 38 or 39, wherein one or more of the plurality of movable eyelets is configured to rotate with respect to the base.

42. The surgical training device of claims 38 or 39, wherein the plurality of movable eyelets spring back to the biased position when moved away from the biased position.

43. A surgical training device comprising:

a base having an outer surface; and

a plurality of covered eyelets connected to the base, wherein each of the plurality of the covered eyelets having a head portion at a distal end connected to a neck portion and covered with a layer of a penetrable material, wherein the neck portion is connected to the base at a proximal end of each of the plurality of movable eyelets, and wherein the head portion having an aperture defining an aperture plane having a first side and a second side,

wherein the plurality of covered eyelets are configured with respect to the base such that at least one aperture is angled with respect to at least one other aperture plane of the plurality of

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covered eyelets, wherein at least a subset of the plurality of covered eyelets defines a pathway with apertures that are sized for passing a suture and suture needle, wherein the passing of the suture and suture needle requires the layer of penetrable material to be pierced by the suture needle, wherein at least one eyelet of the plurality of covered eyelets positioned above the outer surface is retractable to a different position below the outer surface, the at least one eyelet biased towards the position below the outer surface.

44. A surgical training device, comprising:

a device base;

a top cover spaced apart from the device base to define an internal cavity between the top cover and the device base;

at least one aperture or a penetrable region for accessing the internal cavity;

a laparoscopic camera disposed inside the internal cavity and configured to display video images on a video monitor connected to the camera and located outside of the internal cavity; and

a model removably disposed inside the internal cavity such that the model is substantially obscured from a user yet observable via the laparoscopic camera displaying video images of the model on the video monitor, the model comprising a model base having an outer surface and a plurality of covered eyelets that are connected to the model base, wherein the covered eyelets are each covered by a layer of a penetrable material, wherein a subset of the plurality of covered eyelets define a custom pathway for practicing the passing of at least one needle and suture through one or more of the plurality of covered eyelets of the custom pathway, wherein the passing of the at least one needle requires the layer of the penetrable material to be pierced by the at least one needle, and wherein at least one eyelet of the plurality of covered eyelets positioned above the layer of the penetrable material is retractable to a different position below the layer of the penetrable material, the at least one eyelet biased towards the position below the layer of the penetrable material.

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45. The surgical training device of claim 43 or 44, wherein the penetrable material comprises of one or more of mesh or fabric reinforcement.

46. The surgical training device of claim 43 or 44, wherein the penetrable material mimics real tissue.

47. A surgical training device comprising:

a base having an outer surface; and

a plurality of embedded eyelets connected to the base, each of the plurality of embedded eyelets having a head portion at a distal end connected to a neck portion, the neck portion is connected to the base at a proximal end of each of the plurality of the embedded eyelets, and the head portion having an aperture defining an aperture plane having a first side and a second side,

wherein the plurality of embedded eyelets are configured with respect to the outer surface such that at least a portion of each of the plurality of embedded eyelet are retracted at a first position below the outer surface, wherein each of the plurality of embedded eyelets are extractable from the first position to a second position above the outer surface, wherein one or more of the plurality of embedded eyelets are biased towards the first position, and wherein at least a subset of the plurality of embedded eyelets defines a pathway with apertures that are sized for passing a suture and suture needle.

48. A surgical training device, comprising:

a device base;

a top cover spaced apart from the device base to define an internal cavity between the top cover and the device base;

at least one aperture or a penetrable region for accessing the internal cavity;

a laparoscopic camera disposed inside the internal cavity and configured to display video images on a video monitor connected to the camera and located outside of the internal cavity; and

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a model removably disposed inside the internal cavity such that the model is substantially obscured from a user yet observable via the laparoscopic camera displaying video images of the model on the video monitor, the model comprising a model base having an outer surface and a plurality of embedded eyelets that are connected to the model base, wherein the plurality of embedded eyelets are configured with respect to the outer surface such that at least a portion of each of the plurality of embedded eyelet are retracted at a first position below the outer surface, wherein each of the plurality of embedded eyelets are extractable from the first position to a second position above the outer surface, wherein one or more of the plurality of embedded eyelets are biased towards the first position, and wherein a subset of the plurality of retracted eyelets define a custom pathway for practicing the passing of at least one needle and suture through one or more of the plurality of embedded eyelets of the custom pathway.

49. The surgical training device of claim 47 or 48, wherein each of the plurality of retracted eyelets that are biased towards the first position are configured to retract back below the outer surface when released.

50. The surgical training device of claim 47 or 48, wherein the plurality of embedded eyelets are further removable.

51. The surgical training device of claim 47 or 48, wherein the plurality of embedded eyelets are further angled.

52. The surgical training device of claim 47 or 48, wherein the plurality of embedded eyelets are further covered with a penetrable material.

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53. A surgical training device comprising:

a model base having an outer surface; and

a plurality of eyelets that are connected to the model base, wherein at least one of the plurality of eyelets positioned at a first position above the outer surface is retractable to a second position below the outer surface and biased towards the second position.

54. A surgical training device comprising:

a model base having an outer surface; and

a plurality of eyelets that are connected to the model base, wherein at least one of the plurality of eyelets has a first position at a first distance above the outer surface and is retractable to a second position above the outer surface but that is closer to the outer surface than the first position, and wherein the at least one of the plurality of eyelets is biased towards the second position.

55. The surgical training device of claims 53 or 54, wherein the plurality of eyelets are biased via a spring.

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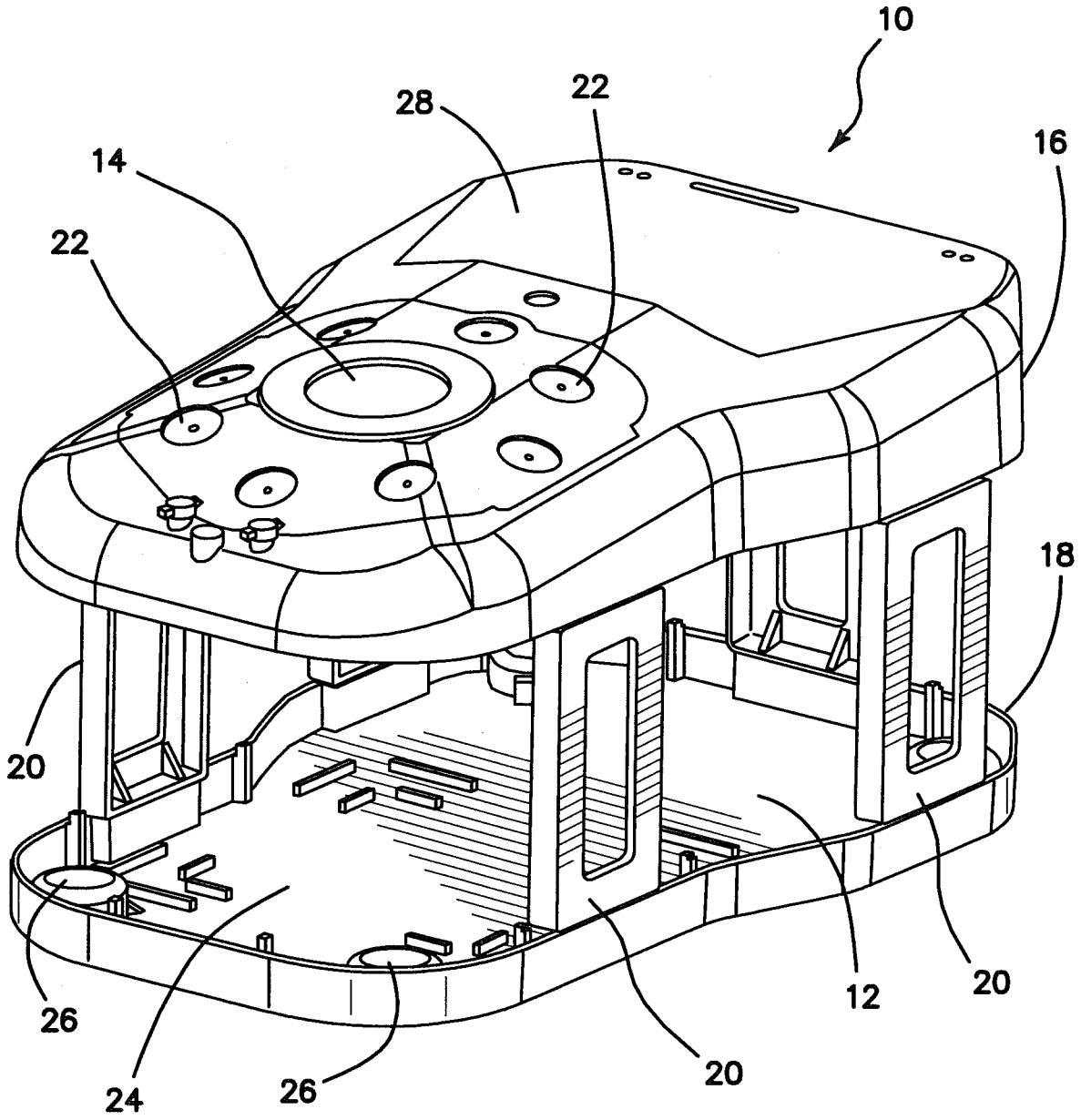


FIG. 1

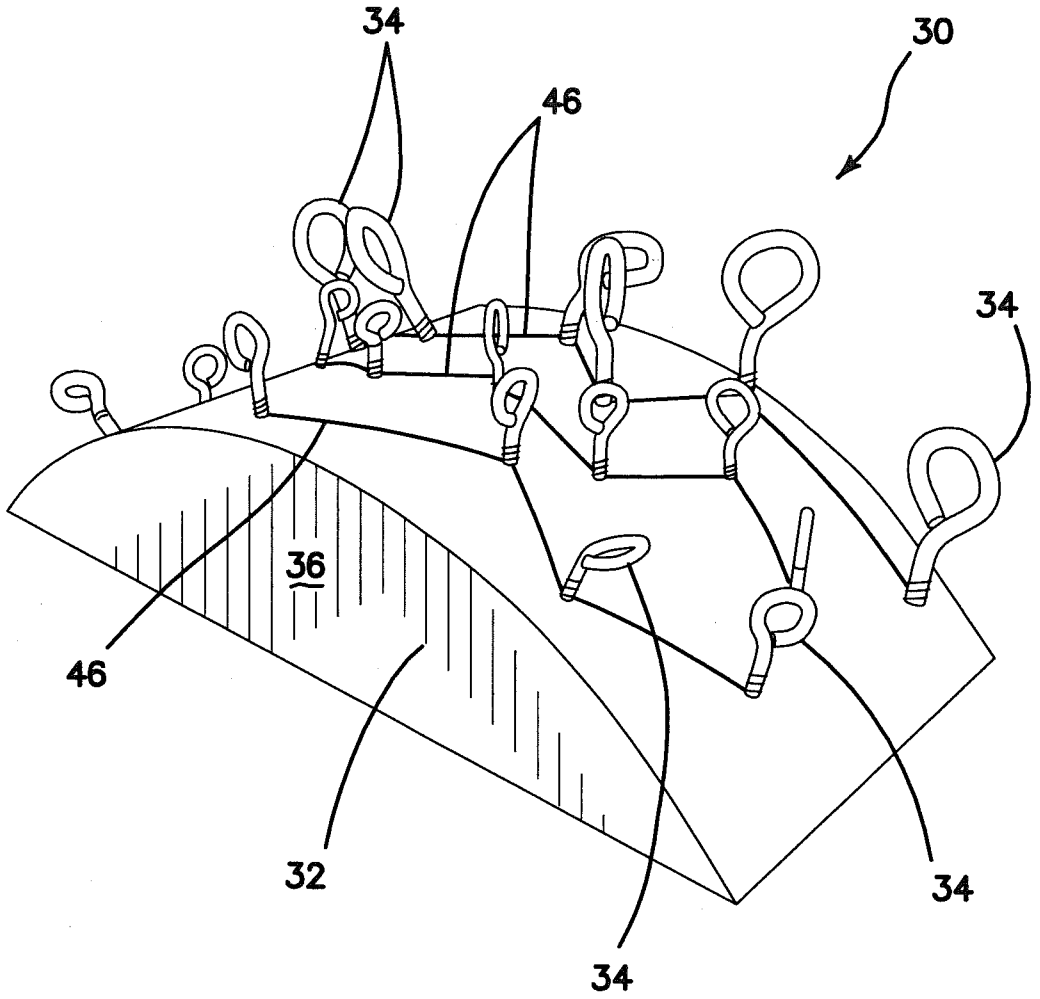


FIG. 2

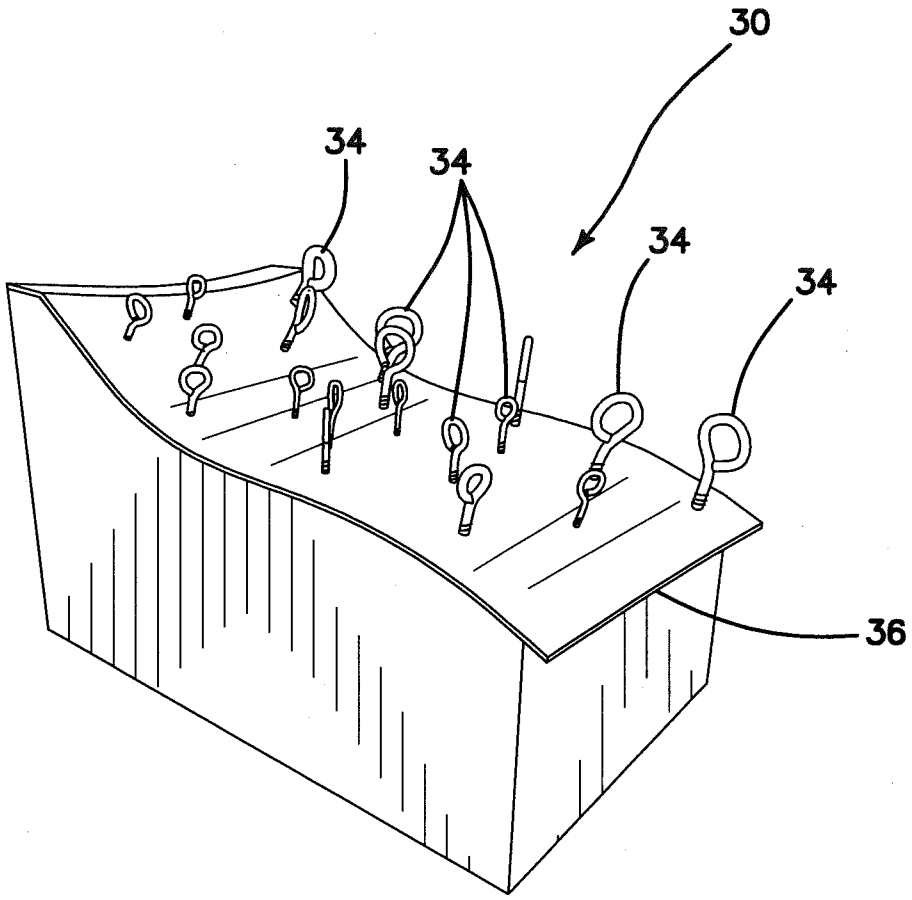


FIG. 3

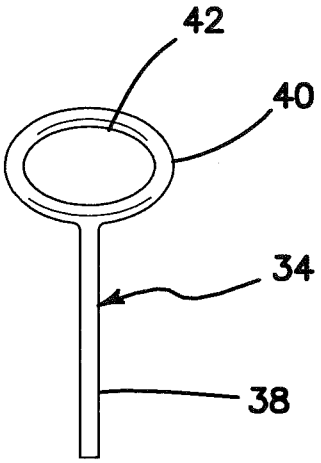


FIG. 4A

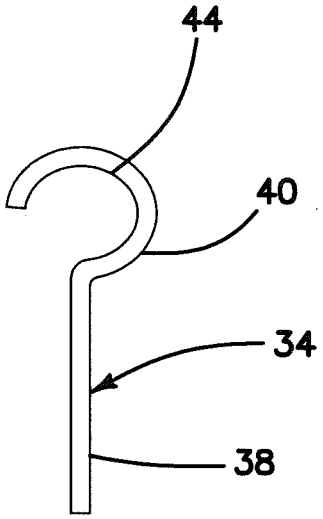


FIG. 4B

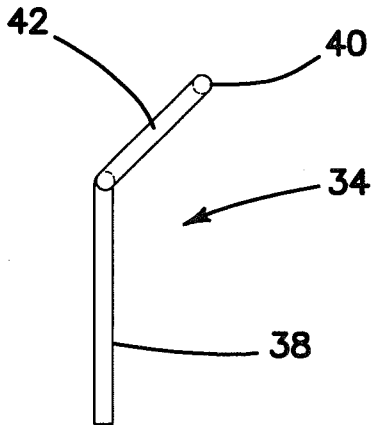


FIG. 4C

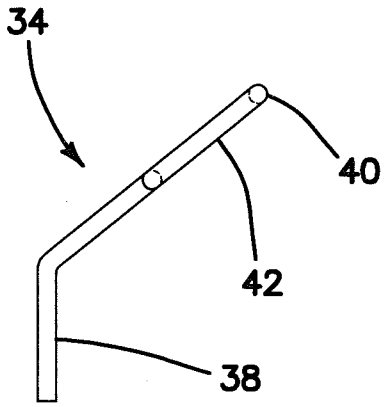
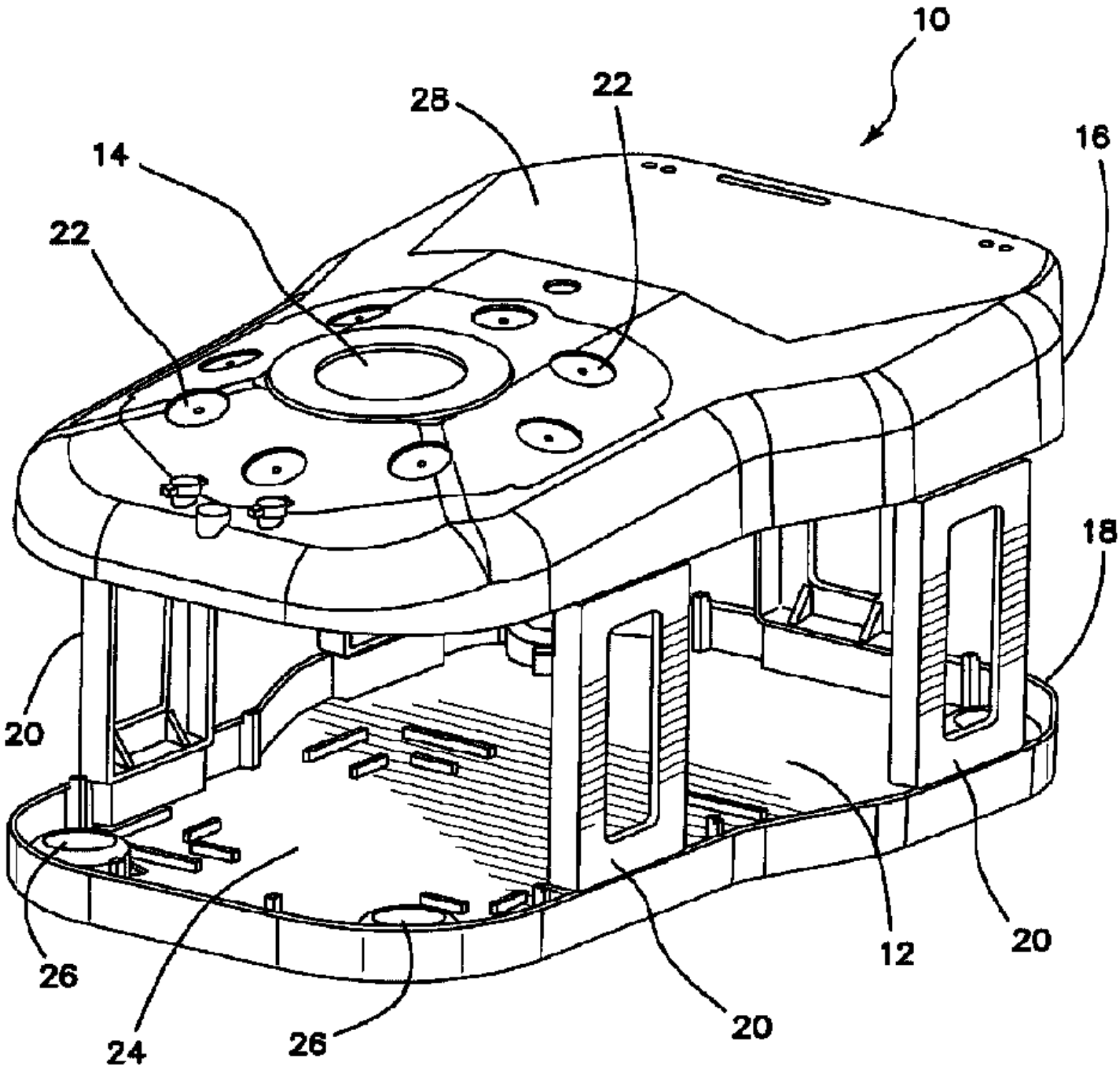


FIG. 4D


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