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SURGICAL GUIDE WIRE ENGAGEMENT DEVICE

Abstract

Medical devices are disclosed for compression of tissue and/or implants via a guide wire during provisional reduction in fracture fixation surgeries and other types of surgeries. Accordingly, an example device includes a housing with first and second apertures and a longitudinal axis. The device also includes a plate inside that itself includes a third aperture. The third aperture establishes a plane that is oblique with respect to the longitudinal axis while the plate is under spring bias from a spring in the housing. The spring helps maintain the oblique angle with respect to the longitudinal axis to lock the medical device at a desired position along the wire while the wire concurrently extends through the first, second, and third apertures. Methods for manufacturing, providing, and using the medical device(s) are also disclosed.

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Background/Summary

FIELD

[0001] The disclosure below relates generally to surgical guide wire engagement devices for use in fracture reductions and other surgical procedures.

BACKGROUND

[0002] Kirschner wires (K-wires) are often used to aid in the alignment and provisional reduction of fractures and implants during fracture fixation surgery in a human patient. K-wires come in different diameters, lengths, and materials. They have at least one trochanteric drilling tip and in some cases a fluted tip. Some are smooth along the length and others have a threaded tip or ridges at the tip to improve bone purchase. K-wires help in orthopedic surgery as they create a very small hole that minimizes impact on the bone, thus allowing a surgeon several attempts at provisional reduction placement without significant bone loss. K-wires align bone fragments and implants in two planes of fixation.

[0003] However, one downside of K-wires is that they offer little to no compression (e.g., they do not align or compress in the third plane). Olive wires (OWs) and plate tacks (PTs) have been used to offer a slight improvement in reduction. Yet even here, the “olive” or “tack” is in a fixed position which prevents ideal wire purchase and/or depth. For threaded OW and PT, the bone thread interface often gets stripped because the wire is inserted at high speeds with a drill and advanced until the olive or tack is stopped by an implant or tissue, thus stripping the bone thread interface because the wire is still spinning but no longer advancing. One additional problem with OW and PT is that when inserted in a screw hole of a plate, a starting position off center will result in the olive or tack “kicking” the plate to the side as the olive or tack interacts with the plate hole.

[0004] There are also issues with locating and configuring a clamp to assist with provisional reduction, as this often requires another incision that is otherwise unnecessary. Also, the clamp might have to clamp down on other important and healthy bone, vascular structure, and nerve structure, which can damage those parts of the body. Clamps are also often quite crude in terms of the pressure they apply.

[0005] There are currently no adequate solutions to the foregoing problems.

SUMMARY

[0006] Accordingly, the disclosure below relates to technology that allows precise compression of tissue and/or implants over a K-wire, Steinmann pin, and/or other alignment mechanism during provisional reduction of fractures and implants during fracture fixation surgery in a human patient. A surgeon or other physician may thus verify an intended alignment, minimizing impact on the bone during provisional reduction placement without significant bone loss and prior to permanent reduction placement/fixation. Thus, the example devices discussed below may establish a movable pill or tack that can lock at any point along the K-wire, Steinmann pin, or other alignment wire/element.

[0007] Accordingly, in one aspect a medical device includes a housing with an elongated body. The housing defines a longitudinal axis. The housing includes a first end portion and a second end portion. The first end portion includes a first aperture while the second end portion includes a second aperture. The first aperture has a first height and first width establishing a first plane perpendicular to the longitudinal axis, and the second aperture has a second height and a second

width establishing a second plane perpendicular to the longitudinal axis. The first and second planes are parallel to each other. The medical device also includes a plate disposed within the housing. The plate includes a third aperture having a third height and a third width establishing a third plane. The third plane is oblique with respect to the longitudinal axis while the plate is under spring bias from a spring in the housing. The first, second, and third apertures are at least partially aligned for a surgical guide wire to concurrently extend through the first, second, and third apertures while the plate is under spring bias from the spring. The spring bias is toward the first end portion. The spring is configured in the housing to impose the spring bias on the plate at a first area of the plate to help maintain the oblique angle of the third plane with respect to the longitudinal axis, and to impede withdrawal of the surgical guide wire from the third aperture toward the first aperture while the surgical guide wire extends through the third aperture. Additionally, a second area of the plate is configured within the housing to rest against a fulcrum within the housing. The plate is configured within the housing to rotate against a fulcrum during advancement of the surgical guide wire through the third aperture from the direction of the first aperture due to friction force during the advancement between the surgical guide wire and one or more plate portions around the third aperture. The friction force brings the third plane closer to parallel with the first and second planes. Still further, the medical device includes a release mechanism coupled to the housing. The release mechanism is manipulable to move the plate about a fulcrum to counteract the spring bias and permit withdrawal of the surgical guide wire from the third aperture toward the first aperture.

[0008] In some example embodiments, the spring may be a first spring. Here, the first end portion may include first and second telescoping members that slide with respect to each other according to the longitudinal axis. The first telescoping member may be more distal relative to the plate than the second telescoping member. The first telescoping member may be configured to slide toward the plate to compress a second spring on the housing that exerts force on the first telescoping member to push the first telescoping member away from the second telescoping member.

[0009] Also in some example embodiments, the housing may include a force gauge that indicates an amount of force the second spring exerts on the first telescoping member.

[0010] If desired, the housing may be at least partially cylindrical. Also if desired, a first distal external surface of the first end portion may be rounded to establish a convex first end of the housing. The first distal external surface may include the first aperture. A second distal external surface of the second end portion may be flat in a plane perpendicular to the longitudinal axis, and the second distal external surface may oppose the first distal external surface and include the second aperture.

[0011] In various example implementations, the release mechanism may include a slider that slides longitudinally along the housing to move the plate about a fulcrum to counteract the spring bias and permit withdrawal of the surgical guide wire from the third aperture through the first aperture. Additionally or alternatively, the release mechanism may include a lever coupled to the plate, where the lever may be manipulable to move the plate about a fulcrum to counteract the spring bias and permit withdrawal of the surgical guide wire from the third aperture through the first aperture. In some instances, the lever may be integral with the plate.

[0012] Also in example implementations, the housing may include a channel connecting the first, second, and third apertures for the surgical guide wire to concurrently extend through the first, second, and third apertures.

[0013] Still further, in some non-limiting examples the medical device may include a hand-held advancement mechanism. The housing may be couplable to the hand-held advancement mechanism to advance the housing along the surgical guide wire using the hand-held advancement mechanism while the surgical guide wire extends through the first, second, and third apertures.

[0014] Additionally, in some cases the first and second apertures may be circular. The first height and first width may thus both be measures of a first diameter of the first aperture, while the second

height and second width may both be measures of a second diameter of the second aperture. What's more, if desired the third aperture may also be circular and, in such cases, the third height and third width may both be a measure of a third diameter of the third aperture. However, note that in other non-limiting examples one or more of the first, second, and/or third apertures may be oblong.
[0015] In some cases the medical device may also include the surgical guide wire.
[0016] Also note that if desired, the plate may be constrained/captured within the housing so that the third aperture remains at least partially aligned with the first and second apertures to receive the wire notwithstanding rotation of the plate within the housing. In another aspect, a device includes a housing with an elongated body. The housing defines a longitudinal axis. The housing includes a first end portion and a second end portion. The first end portion includes a first aperture. The second end portion includes a second aperture. The first aperture has a first height and first width establishing a first plane, and the second aperture has a second height and a second width establishing a second plane. The device also includes a first element disposed within the housing. The first element includes a third aperture. The third aperture has a third height and a third width establishing a third plane. The third plane is oblique with respect to the longitudinal axis while the first element is under bias from a second element in the housing. The first, second, and third apertures are at least partially aligned for a wire to concurrently extend through the first, second, and third apertures while the first element is under bias from the second element. The bias is toward the first end portion. The second element is configured in the housing to impose the bias on the first element at a first area of the first element to help maintain the oblique angle of the third plane with respect to the longitudinal axis, and to impede withdrawal of the wire from the third aperture toward the first aperture while the wire extends through the third aperture. A second area of the first element is configured within the housing to rest against a fulcrum within the housing. The first element is configured within the housing to rotate during advancement of the wire through the third aperture from the direction of the first aperture due to friction force during the advancement between the wire and one or more first element portions around the third aperture.
[0017] In some example embodiments, the device may also include a release mechanism coupled to the housing. The release mechanism may be manipulable to move the first element about a fulcrum to counteract the bias and permit withdrawal of the wire from the third aperture through the first aperture.
[0018] Additionally, in some examples the device may also include a hand-held advancement mechanism. The housing may be couplable to the hand-held advancement mechanism to advance the housing along the wire using the hand-held advancement mechanism while the wire extends through the first, second, and third apertures.
[0019] Still further, in some cases the first end portion may include first and second telescoping members that slide with respect to each other according to the longitudinal axis. The first telescoping member may be more distal relative to the first element than the second telescoping member. The first telescoping member may be configured to slide toward the first element to compress a third element on the housing that exerts force on the first telescoping member to push the first telescoping member away from the second telescoping member.
[0020] In still another aspect, a method includes providing a housing with an elongated body. The housing defines a longitudinal axis. The housing includes a first end portion and a second end portion. The first end portion includes a first aperture. The second end portion includes a second aperture. The first aperture has a first height and first width establishing a first plane, and the second aperture has a second height and a second width establishing a second plane. The method also includes providing a first element disposed within the housing. The first element includes a third aperture. The third aperture has a third height and a third width establishing a third plane. The third plane is oblique with respect to the longitudinal axis while the first element is under bias from a second element in the housing. The first, second, and third apertures are at least partially aligned for a wire to concurrently extend through the first, second, and third apertures while the first

element is under bias from the second element. The bias is toward the first end portion. The second element configured in the housing to impose the bias on the first element at a first area of the first element to help maintain the oblique angle of the third plane with respect to the longitudinal axis, and to impede withdrawal of the wire from the third aperture toward the first aperture while the wire extends through the third aperture. A second area of the first element is configured within the housing to rest against a fulcrum within the housing. The first element is configured within the housing to rotate during advancement of the wire through the third aperture from the direction of the first aperture due to friction force during the advancement between the wire and one or more first element portions around the third aperture.

[0021] In some example instances, the housing and first element may be provided as part of a medical device. Here, the method may also include using the medical device and wire to maintain alignment of a first bone segment with another object during a surgical procedure. The other object may include a second bone segment and/or a surgical plate.

[0022] The details of the present application, both as to its structure and operation, can best be understood in reference to the accompanying drawings, in which like reference numerals refer to like parts, and in which:

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. **1**A shows a front isometric view of a first example embodiment of a medical device consistent with present principles;

[0024] FIG. **1**B shows a rear isometric view of the first example embodiment of the medical device consistent with present principles;

[0025] FIGS. **1**C-**1**G show various orthogonal views of the first example embodiment of the medical device consistent with present principles;

[0026] FIG. **2** shows an exploded view of the first example embodiment of the medical device consistent with present principles;

[0027] FIG. **3** shows a side cross-sectional view of the first example embodiment of the medical device consistent with present principles;

[0028] FIG. **4** shows a rear lower isometric view of the first example embodiment of the medical device consistent with present principles;

[0029] FIGS. **5**A and **5**B show orthogonal views of the first example embodiment of the medical device consistent with present principles to demonstrate different example force gauges that may be used;

[0030] FIG. **6**A shows a front isometric view of a first example embodiment of a hand-held advancement mechanism that may be used with the device of FIGS. **1**-**5**B consistent with present principles;

[0031] FIG. **6**B shows a rear isometric view of the first example embodiment of the hand-held advancement mechanism consistent with present principles;

[0032] FIG. **6**C shows an exploded view of the first example embodiment of the hand-held advancement mechanism consistent with present principles;

[0033] FIGS. **6**D-**6**G show various orthogonal views of the first example embodiment of the hand-held advancement mechanism consistent with present principles;

[0034] FIG. **6**H shows a cross-sectional view of the first example embodiment of the hand-held advancement mechanism consistent with present principles;

[0035] FIG. **6**I shows another orthogonal view of the first example embodiment of the hand-held advancement mechanism consistent with present principles;

[0036] FIGS. **6**J and **6**K show cutaway views of a wire extending through apertures and a channel

of the first example embodiment of the hand-held advancement mechanism consistent with present principles;
[0037] FIG. **7**A shows a front isometric view of a second example embodiment of the hand-held advancement mechanism consistent with present principles;
[0038] FIG. **7**B shows a rear isometric view of the second example embodiment of the hand-held advancement mechanism consistent with present principles;
[0039] FIG. **7**C shows an exploded view of the second example embodiment of the hand-held advancement mechanism consistent with present principles;
[0040] FIG. **7**D shows an orthogonal side view of the second example embodiment of the hand-held advancement mechanism consistent with present principles;
[0041] FIGS. **7**E shows a cross-sectional view of the second example embodiment of the hand-held advancement mechanism consistent with present principles;
[0042] FIG. **8**A shows a front isometric view a third example embodiment of the hand-held advancement mechanism consistent with present principles;
[0043] FIG. **8**B shows an exploded view of the third example embodiment of the hand-held advancement mechanism consistent with present principles;
[0044] FIGS. **8**C-**8**D show orthogonal views of the third example embodiment of the hand-held advancement mechanism consistent with present principles;
[0045] FIG. **9**A shows a front isometric view of a second example embodiment of a medical device similar to the device of FIGS. **1**A-**3** consistent with present principles;
[0046] FIG. **9**B shows a rear isometric view of the second example embodiment of the medical device consistent with present principles;
[0047] FIGS. **9**C-**9**G show various orthogonal views of the second example embodiment of the medical device consistent with present principles;
[0048] FIG. **9**H shows an exploded view of the second example embodiment of the medical device consistent with present principles;
[0049] FIG. **9**I shows a side cross-sectional view of the second example embodiment of the medical device consistent with present principles;
[0050] FIG. **10**A shows a front isometric view of a third example embodiment of a medical device similar to the device of FIGS. **1**A-**3** consistent with present principles;
[0051] FIG. **10**B shows a rear isometric view of the third example embodiment of the medical device consistent with present principles;
[0052] FIGS. **10**C-**10**G show various orthogonal views of the third example embodiment of the medical device consistent with present principles;
[0053] FIG. **10**H shows an exploded view of the third example embodiment of the medical device consistent with present principles;
[0054] FIG. **10**I shows a side cross-sectional view of the third example embodiment of the medical device consistent with present principles;
[0055] FIG. **11**A shows a front isometric view of a fourth example embodiment of a medical device similar to the device of FIGS. **1**A-**3** consistent with present principles;
[0056] FIG. **11**B shows an exploded view of the fourth example embodiment of the medical device consistent with present principles;
[0057] FIG. **11**C shows an orthogonal side view of the fourth example embodiment of the medical device consistent with present principles;
[0058] FIG. **11**D shows a side cross-sectional view of the fourth example embodiment of the medical device consistent with present principles;
[0059] FIG. **12** shows an innovative guide wire that may be used consistent with present principles;
[0060] FIG. **13** shows other example guide wires that may be used consistent with present principles;
[0061] FIG. **14** shows an example method in flow chart format for surgically using a medical

device consistent with present principles;
[0062] FIG. **15** shows an example method in flow chart format for manufacturing a medical device consistent with present principles;
[0063] FIG. **16** shows an example method in flow chart for providing a medical device consistent with present principles; and
[0064] FIGS. **17-20** show various example use cases of the medical devices disclosed herein consistent with present principles.

DETAILED DESCRIPTION

[0065] Disclosed below are medical devices that allow compression of tissue and/or implants along a K-wire, Steinmann pin, and/or other alignment mechanism during provisional reduction of fractures in fracture fixation surgery for a human patient. Refined pressure of a desired amount may be applied using these devices, with the pressure being visually and tactilely demonstrated through one example device's sprung nose and force gauge. A surgeon or other physician may thus verify an intended bone alignment while reducing impact on the bone during provisional reduction, also minimizing significant bone loss that might otherwise occur prior to permanent reduction fixation. Accordingly, the example devices discussed below may establish a movable bead or tack that can lock at any point along a K-wire, Steinmann pin, or other alignment element due to an innovative collet/camming design, which may take an input force and create a force multiplier that bites into the wire harder and harder as force to withdraw the device from the wire continues to be applied (e.g., absent use of a release mechanism that may be used for withdrawal of the device from the wire as discussed further below).
[0066] Beginning now in reference to FIGS. **1**A and **1**B, an example medical device **100** is shown respectively in front and rear isometric view. The device **100** may be used consistent with present principles to provide an input force at the nose of the device **100** and create a force multiplier at an aperture **260** of a cam plate **250** as described further below to bite down on a surgical guide wire **115**, holding/locking the device **100** in place on the wire **115**.
[0067] Accordingly, as shown in these figures, the medical device **100** may include a housing **105** with an elongated, rigid body. The housing **105** may be made of metal such as medical-grade steel or aluminum, for example. Additionally or alternatively, the housing **105** may be made of hard plastic, hardened polymer, and/or other suitable material. As also shown in these figures, the housing may define a longitudinal axis **110**.
[0068] The housing **105** may be at least partially cylindrical as shown to avoid unintentionally catching on other body tissue in the area of the surgical site. The housing **105** may include a first end portion **140** of a first diameter as well as a second end portion **150** of a second diameter less than the first diameter. However, note that in other embodiments, the first and second diameters may be the same, or the second diameter may be more than the first diameter.
[0069] FIGS. **1**A and **1**B also show that in non-limiting examples, a first distal external surface **170** of the first end portion **140** may be rounded to establish a convex first end of the housing **105**, with the first distal external surface **170** and/or portion **140** more generally including a first aperture **120**. These two figures also show that a second distal external surface **180** of the second end portion **150** may be flat in a transverse plane perpendicular to the longitudinal axis **110**, with the second distal external surface **180** and/or portion **150** more generally including a second aperture **130**. However, in other non-limiting examples both distal external surfaces **170**, **180** may be convex, or may be flat. Further note that the first and second distal external surfaces **170**, **180** may face outward away from each other as shown.
[0070] The external surface(s) may be convex and rounded in non-limiting examples to prevent the device from inadvertently catching or grabbing other things in the surgical environment, which could in turn harm the patient. Also to prevent this from occurring, the exterior surfaces of the housing **105**, including the surfaces **170**, **180**, may be smooth and/or have a polished finish.
[0071] FIGS. **1**A and **1**B also show that the apertures **120**, **130** may be circular in height and width

and cylindrical in depth. The apertures **120**, **130** may have the same or different height/width diameters as each other. The first aperture **120** may therefore have a first height and first width establishing a first plane perpendicular to the longitudinal axis **110**, and the second aperture **130** may have a second height and a second width establishing a second plane perpendicular to the longitudinal axis **110**. In non-limiting examples, the first and second planes may be parallel to each other. The apertures **120**, **130** may help constrain the surgical guide wire **115** as it extends through the device **100**, as illustrated by FIGS. **1**A and **1**B.

[0072] During provisional fracture reduction, the device **100** may therefore receive the surgical guide wire **115** through the first aperture **120**, with the wire **115** then being advanced through a hollow channel **240** and aperture **260** in the plate **250** (shown in the cutaway view of FIG. **3**) to subsequently exit through the second aperture **130** such that the wire **115** then extends longitudinally through the entire device **100**. Owing to the oblique angle of the aperture **260** as described in further detail below, the device **100** may then continue to be advanced down the wire **115** but may not be withdrawn from the wire **115** the opposite way save for manipulation of a release mechanism on the device **100**.

[0073] Accordingly, FIGS. **1**A-**3** show one example release mechanism **160** that may be coupled to the housing **105**, with the release mechanism **160** being a slider/button in this non-limiting example. The release mechanism **160** may be manipulable to move the metal or polymer plate **250** (or more generally, an element **250**) inside the housing **105** about a fulcrum **300**, with the fulcrum **300** shown best in FIG. **3**. This action counteracts a spring bias/biasing moment exerted by a spring **230** inside the housing **105**, permitting withdrawal of the surgical guide wire **115** from the third aperture **260** through the first aperture **120** so the device **100** may be removed from the wire **115** from the same direction from which it was advanced.

[0074] To further illustrate various aspects of the device **100**, note that FIG. **1**C shows the device **100** in top orthogonal view, while FIG. **1**D shows the device **100** in side orthogonal view. FIG. **1**E shows the device **100** in bottom orthogonal view. FIG. **1**F shows the device **100** in front orthogonal view. FIG. **1**G shows the device in rear orthogonal view.

[0075] Additionally, FIG. **2** shows the device **100** in exploded view. As may be appreciated from this figure, the housing **105** includes a device body **200**, front hollow nose cap **210**, and rear spring cap **220**. In non-limiting examples, the nose cap **210** may define some or all of the front end portion **140**, while the rear spring cap **220** may define some or all of the rear end portion **150**.

[0076] As also shown in FIG. **2** and further illustrated in the cross-sectional longitudinal side view of FIG. **3** (showing the device **100** as assembled), the device **100** may include the aforementioned cam plate **250** disposed within the housing **105**. The cam plate **250** may include the third aperture **260**. The third aperture **260** may have a third height and a third width establishing a third plane, where the third plane is oblique with respect to the longitudinal axis **110** while the plate **250** is under spring bias from the spring **230** in the housing **105**. The oblique angle of the third plane (e.g., when the plate **250** is at rest under spring bias from the spring **230**) may be between eighty five and twenty degrees relative to the longitudinal axis **110** in various non-limiting embodiments, and preferably eighty to fifty degrees and even sixty degrees in particular in specific non-limiting examples. Thus, as best shown in FIG. **3**, the first aperture **120**, second aperture **130**, and third aperture **260** may be at least partially aligned for the surgical guide wire **115** to concurrently extend through the first, second, and third apertures while the plate **250** is still under spring bias from the spring **230** and obliquely oriented. The hollow channel **240** as shown in FIG. **3** may thus extend longitudinally through the transverse center of the housing **150** to fluidly connect the apertures **120**, **130**, and **200** for the wire **115** to concurrently extend through all three apertures and the channel **240** itself (despite the third plane of the third aperture **200** being oblique with respect to the longitudinal axis and hence not parallel to the first and second planes of the first and second apertures).

[0077] Describing the spring **230** in more detail, the spring **230** may be a compression spring (e.g.,

helical or conical) to oppose compression along the spring's longitudinal axis. However, other types of springs may also be used (e.g., leaf springs), and for that matter other types of elements configured for material bias may also be used in addition to or in lieu of a spring. For example, a semi-rigid polymer may be configured in a particular bowed shape to also exhibit a desired bias. But regardless of whether a spring or other type of biased element is used, note that the bias may be toward the first end portion **140** such that the spring/element **230** resists force/compression from the plate **250** toward the rear end portion **150**. To this end, note that the distal segment of the spring **230** may be mounted onto a post **235**. The post **235** may be made integral with the cap **200** and extend longitudinally within the housing **105** (e.g., parallel to the longitudinal axis **110**). The proximal segment of the spring **230** may then be configured within the housing **150** to abut and impose the spring bias on the plate **250** at a first (upper) area of the plate **250** to help maintain the oblique angle of the third plane with respect to the longitudinal axis **110** and to therefore also impede withdrawal of the surgical guide wire **115** from the third aperture **260** toward the first aperture **120** while the surgical guide wire **115** extends through the third aperture **260**.

[0078] FIG. **4** is a rear isometric view that further illustrates, with it being noted that the rear spring cap **220** has been omitted to show the first area **400** of the plate **250** mentioned above (the area against which the spring **230** imposes the spring bias to help maintain the aforementioned oblique angle of the third plane). It may also be appreciated from FIG. **4** that the example plate **250** has a generally circular shape in the plate center that itself defines the third aperture **260**. The plate **250** also has tabs extending up and down as shown. The upper tab establishes some or all of the first area **400** as generally facing toward the rear of the device. Additionally, the lower tab establishes some or all of a second area of the plate **250** as generally facing toward the front of the device **100**. The second area is thus configured within the housing **105** to rest against the fulcrum **300** mounted or made integral with the housing **105**. Accordingly, referring back to FIG. **3** for a moment, note that the fulcrum **300** may be established by an inner portion of the body **200** that is rounded from vertical to horizonal, device back to device front. However, further note that other fulcrum configurations are also encompassed by present principles.

[0079] Also note per FIG. **4** that the plate **250** is constrained not just by the fulcrum **300** but also by inner sidewalls of the housing **105** establishing an opening for the plate **250**. This opening may therefore be shaped like the plate itself but may be slightly larger than the plate **250** to closely receive the plate **250** and constrain it from jostling sideways and up/down in an X-Y plane of the device **100** (the X-Y plane being perpendicular to the longitudinal axis and cutting transversely through the device **100**). However, owing to their configuration, these cam plate constraint features still allow controlled radial/rotational movement of the plate **250** about the fulcrum **300** in the Z dimension. To further constrain the plate **250** while allowing this controlled movement, a longitudinally-extending element **420** on the cap **220** may abut the rear-facing portion of the lower tab of the plate **250**, where the elements **420** and **300** form a pocket or hinge helping to maintain alignment of the apertures **120**, **260**, **130** even when the plate **250** is obliquely oriented.

[0080] It may be further appreciated from these figures that the plate **250** is configured within the housing **105** to rest against the element **420** and counteract the bias from the spring **230** during advancement of the wire **115** through the third aperture **260** from the direction of the first aperture **120**. This plate resting against the element **420** during advancement is effected due to the friction force that is created between the wire **115** and plate portions around the aperture **260** as the device **100** is advanced down the wire **115**. Accordingly, the friction force rotates the third plane of the third aperture **260** closer to parallel with the first and second planes to the first and second apertures **120**, **130**.

[0081] Based on the foregoing, it is to be even further understood that when the release mechanism **160** is activated, the release mechanism **160** unloads the plate **250**/wire interface, with the plate **250** rotating within the pocket formed by fulcrum **420** and **300** to become more parallel. Thus, fulcrum **420** and **300** may both contain the plate **250** in the device **100** and form a point of rotation for plate

rotation (e.g., when the release mechanism is active, moving the plate **250** closer to parallel). Thus, if the device **100** is holding load, that load is acting through fulcrum **300**. Then to release the load, first the spring **230** is compressed until the plate **250**/wire interface releases and then the plate may rotate and slide against the fulcrum **300**. Accordingly, the structures of the elements **300** and **420** may together form a pocket or hinge point within which the plate can rotate.

[0082] Referring back to FIGS. **2** and **3** and further describing this pocket or hinge point created by the fulcrum **300** and element **420** of the device **100**, the hinge point could instead be created by a pin and hinge assembly where a hole is formed cross-wise in the end near the second area of the plate **250** with an axis of this hole perpendicular to the longitudinal axis **110** of the device **100** and another hole formed in the body **200** such that it may be substantially aligned and concentric with the hole formed in the end of the plate **250**. A pin made of metal or hard plastic or other substantially rigid and strong material may be positioned and assembled through these aligned holes in the plate **250** and body **200** to couple these components together and form a pinned-hinge connection.

[0083] Referring back to FIGS. **2** and **3** and describing other aspects of the device **100**, the first end portion **140** of the device **100** may also include telescoping members that slide with respect to each other according to the longitudinal axis **110**. In the present example, the nose cap **210** establishes one of the telescoping members and has a larger diameter than a second telescoping member **270** on the body **200** (though in other example embodiments the nose cap **210** may have a smaller diameter than the member **270** and telescope inside the body **200**/member **270**). The first telescoping member **210** is therefore distal to the plate **250** while the second telescoping member **270** is proximal to the plate **250**.

[0084] As also shown in FIGS. **2** and **3**, the first telescoping member **210** may be configured to slide toward the plate **250** to counteract bias from and compress a nose compression spring **290** on (e.g., in) the housing **105** that exerts force on the first telescoping member **210** to push the first telescoping member **210** distally away from the second telescoping member **270**. The cross-sectional view of FIG. **3** thus illustrates that when the device **100** is assembled, the spring **290** extends longitudinally within the housing **105** so that it is coaxial with or at least parallel to the longitudinal axis **110**, abutting one or more proximal walls **310** in the body **200** at the proximal end and abutting the inside front walls **320** of the hollow nose cap **210** at the distal end. Further note that the inside of the spring **290** may help establish some of the channel **240**.

[0085] However, note that in other embodiments, the spring **290** may be located outside the housing body **200**/member **270** such that the inner diameter of the spring **290** is greater than the outer diameter of the distal end of the housing (**200**/**270**). Additionally, in some examples the spring **290** may be integral with the housing **200**/**270**.

[0086] Also note in terms of the distal nose cap **210** that it may be attached to the member **270** using a ring/rib on the external surface of the member **270** (circumscribing a transverse segment of the member **270**) such that the nose cap **210** may be snapped over the ring/rib to couple to the member **270**. The nose cap **210** may also have a relief region (e.g., of a greater diameter than the member **270**) that allows telescoping movement but keeps the nose **210** attached to the body **200**/**270** such that it cannot slide distally off past the ring/rib.

[0087] The telescoping members **210**, **270** and nose spring **290** are thus configured to reduce and absorb backlash in cam plate engagement with the wire **115**, since slight wire travel within the device **100** can occur before the wire **115** gets cinched/bound in the third aperture **260** after advancement to a desired wire location. And to reiterate, once at the desired wire location, the device **100** may help maintain a compression force along the wire **115** between bone fragments and/or plates for ascertaining proper bone and/or plate alignment during fracture reduction or other bone repair (e.g., before much larger holes are drilled into the bone to insert screws or other fasteners for permanent fixation).

[0088] Thus, in one example, a physician may advance the device **100** up against the plate or bone,

positioning the device **100** up against the plate/bone with slightly more compression force than ultimately desired to hold the device **100** at the desired wire position so that the telescoping elements may absorb the wire travel and ultimately hold the device **100** at the desired wire position with the desired amount of compression force. A force gauge **190** as also shown in various figures may further aid the physician in this task. In one example, the gauge **190** may be established by notches in an external surface of the body **200**, where those notches provide an indication of the amount of force between cap **210** and body **200** due to the bias from the spring **290**. Example force gauges **190***a* and **190***b* will be described in greater detail later in reference to FIGS. **5**A and **5**B.

[0089] But still in reference to FIGS. **2** and **3** and describing the one or more release mechanisms **160** in more detail, again note per the example shown that the mechanism(s) **160** include a slider button as shown. To slide longitudinally along the housing **105**, the slider **160** may have a female track **280** mountable on a male track **285** on the body **200** to constrain the slider **160** from being removed up away from the body **200** and transversely across the body **200**, while still permitting longitudinal movement along the combined track **280**/**285**. Accordingly, when the device **100** is assembled as shown in FIG. **3**, the rear portion of the slider **160** may abut the upper tab of the plate **250** such that a physician may take his/her finger(s) and slide the slider **160** back to rotate the plate **250** about the fulcrum **300**. This action counteracts the spring bias from the spring **230** to bring the third plane of the third aperture **260** closer to parallel with the first and second planes to permit the wire **115** to be removed/withdrawn out of the first aperture **120** unencumbered by some or all of the cinch/binding action caused by the oblique angle of the third aperture **260** itself while the wire **115** extends through the third aperture **260**. Also note that owing to the plate **250** having bias from the spring **230** exerted against it as described above, the slider **160** is also biased in a similar manner absent the physician sliding it back. However, further note that in some non-limiting examples, transverse ridges or ribs **287** on the upper portion of the track **285** may also receive reciprocal notches on the lower portions of the slider track **280** to provide some friction force to help maintain the slider **160** at a desired position on the track despite spring bias.

[0090] For completeness and before moving on to other figures, note that one or more of the body **200**, cap **210**, and/or cap **220** may be made integrally with each other, and/or may be engaged via snap fit, adhesive, etc. Either way, once coupled together, these components help to constrain the inner parts of the device **100** to bind and release the wire **115** from the third aperture **260** as desired to help with alignment of bone(s) (such as two bone fragments/segments of a same bone structure like a radius that is to be integral, absent fracture) and/or surgical plates prior to permanent fixation to ensure proper alignment before said permanent fixation.

[0091] Also before moving on to description of other figures, it is reiterated that while the first aperture **120**, second aperture **130**, and third aperture **260** may be circular as shown in the figures described above (with the respective height and width of each aperture both being measures of the respective diameter of the respective aperture itself), in other examples one or more of these apertures may be shaped differently if desired and depending on implementation. For example, one or more of the first, second, and/or third apertures may be oblong instead (e.g., oval-shaped with a long axis transverse to the longitudinal axis **110** sideways across the housing **150**).

[0092] Now in reference to FIGS. **5**A and **5**B, two example implementations of the aforementioned force gauge **190** are shown, both of which may indicate an amount of force the second spring **290** exerts on the first telescoping member (cap **210**). FIG. **5**A shows an example gradient force scale/gauge **190***a* with line markings of increasing width for progressively increasing force, while FIG. **5**B shows an example quantitative force scale/gauge **190***b* with increasing numbers for progressively increasing force.

[0093] Continuing the detailed description in reference to FIGS. **6**A-**6**C, an example hand-held advancement mechanism **600** is shown that may be used with the device **100** consistent with present principles. Specifically, FIGS. **6**A-**6**B show front and rear isometric views of the mechanism **600**, while FIG. **6**C shows an exploded view of the mechanism **600**. The mechanism

600 may establish a compression clamp assembly that may be used to help advance the device **100** along a surgical guide wire rather than doing so purely by hand (as also envisioned consistent with present principles). The mechanism **600** may therefore be helpful as it can be used to advance the device **100** along the wire in a more controlled manner, potentially while also using less force than advancement by hand alone due to the lever action of another cam plate in the mechanism **600**. The housing **105** of the device **100** may therefore be advanced on the guide wire using a pull force implemented by the mechanism **600**, whether the mechanism **600** is physically attached/coupled to the device **100** as shown in later figures or simply as it pushes the device **100** from behind according to the example embodiment of FIGS. **6**A-**6**C.

[0094] As shown in FIGS. **6**A-**6**C, the mechanism may generally be in the shape of a clamp gun and, as such, may include a rigid front arm/trigger **610** that rotates with respect to a rigid body **620** of the mechanism **600** while a rigid rear arm **630** remains immobile with respect to the body **620**. In one particular example, the arm **630** may be made integral with the body **620**, while the arm/trigger **610** may be coupled to another arm **615** that extends horizontally backwards from a lower vertical portion of the body **620** at the front of the body **620** to a front-facing vertical portion of the arm **630** at the rear of the body **620**. Note that the elements **610**, **620**, and **630** may be made of metal such as medical-grade steel or aluminum, hard plastic, hardened polymer, and/or other suitable material.

[0095] As for the coupling of the arm **610** to the arm **615**, this may be done via a metal or polymer pin **640** extending through opposing side holes **645** on the upper end portion of the arm **610**, where the pin **640** also concurrently extends through an aperture **649** on a tab **647** on the body **620** (shown in the exploded view of FIG. **6**C). In this way, the arm **610** is engaged with the body **620** for rotation of the arm **610** about the axis established by the length of the pin **640** (as extending transversely across the body **620**) to rotate the arm **610** radially toward and away from the arm **630** about the pin axis.

[0096] This motion, in turn, results in force being exerted by a curved, rear-facing upper portion of the arm **610** on a metal or polymer cam plate **650** to move the plate **650** from its somewhat upright position or fully upright position as shown in FIGS. **6**A and **6**B (and FIG. **6**D for that matter) to more oblique positions that slope progressively more from top to bottom, front to back. Additionally, note that the plate **650** has a circular or oblong guide wire aperture **655** for the surgical guide wire to extend through the aperture **655** as well as through a front aperture **657** and a rear aperture **659** on the mechanism **600**. The apertures **657**, **659** themselves may be circular or oblong.

[0097] Spring bias from a return spring **690** (such as a compression spring or other biased element) as disposed longitudinally in the body **620** therefore maintains the plate **650** in the somewhat upright position or fully upright position, allowing the wire to move freely through these three apertures on the mechanism **600** as well as through a channel **670** that both extends longitudinally through the body **620** and fluidly connects the apertures themselves (the channel **670** being shown in FIG. **6**H). However, when the arm **610** is pulled back toward the arm **630**, the portions of the plate **650** around the aperture **655** may grip the wire more and more as the plate **650** moves, advancing the mechanism **600** itself further down the wire. This counteracts the spring bias on the plate **650** in the process. Then when the arm **610** is released, the spring bias returns the plate **650** to its more upright position (and returns the arm **610** to its biased forward position in the process).

[0098] Describing the spring **690** in more detail, note that it may be anchored inside a receptacle in the body **620**. As such the front end of the spring **690** may be anchored inside the body **620** itself while the back end of the spring **690** may be anchored to a set screw **695** that is screwed into the backside of the body **620**.

[0099] The motion of the plate **650** as described above may therefore be used to advance the device **100** as located in front of the aperture **657** along the surgical guide wire, with the wire concurrently extending not just through the apertures and channel on the device **100** itself but also through the

apertures and channel on the mechanism **600**. The device **100** and mechanism **600** may thus be incrementally advanced forward together along the guide wire with each pull of the arm **610**, with the mechanism **600** providing a pull action on the wire to move the device **100** forward and then the cam plate aperture **260** in the device **100** cinching the wire itself to hold the device **100** at its newly-advanced position.

[0100] Still in reference to FIGS. **6**A-**6**C, further note that the plate **650** may also include a bar **653** on an uppermost portion, where the bar **653** extends laterally through the body **620** to expose distal portions of the bar **653** external to the body **620**. Those distal portions of the bar **653** may help retain the plate **650** in place to ensure the aperture **655** is properly aligned for wire passage, also allowing rotation and translation of the plate **650**. This structural feature **653** in combination with the surrounding housing of the body **620** may thus hold the plate **650** in its correct position.

[0101] The orthogonal views of FIGS. **6**D-I further illustrate. FIG. **6**D is a side orthogonal view of the mechanism **600**, FIG. **6**E is a front orthogonal view of the mechanism **600**, FIG. **6**F is a rear orthogonal view of the mechanism **600**, and FIG. **6**G is a top orthogonal view of the mechanism **600**. Additionally, FIG. **6**H is a side cross-sectional view of the mechanism **600** while FIG. **6**I is a top orthogonal view of the mechanism **600**.

[0102] Particularly in reference to FIG. **6**H, note that the apertures **657**, **655**, and **659** are connected through the aforementioned hollow channel **670** aligned with the apertures **657**, **655**, and **659** so that the surgical guide wire can concurrently extend through the apertures **657**, **655**, and **659** and channel **670** during advancement as described above. Also note that FIG. **6**J shows an orthogonal cutaway side view of the wire **115** extending through the apertures/channel of the mechanism **600**, while FIG. **6**K shows an isometric cutaway view of the wire extending through the apertures/channel of the mechanism **600**.

[0103] Turning now to FIGS. **7**A-E, another example is shown where the mechanism **600** is made integral with the rear cap **220** and/or body **200** of the device **100** so that the whole unit **100**/**600** may be advanced along a surgical guide wire and then withdrawn when desired. FIG. **7**A is a front isometric view, FIG. **7**B is a rear isometric view, FIG. **7**C is an exploded view, FIG. **7**D is a side orthogonal view, and FIG. **7**E is a side cross-sectional view. The devices **100**, **600** according to FIGS. **7**A-E may therefore be the same as other example embodiments above save for the mechanism **600** and one or more portions of the housing **105** being made integral with each other (instead of, in contrast, the device **100** and mechanism **600** being independent of each other per FIGS. **6**A-**6**K).

[0104] Moving on to FIGS. **8**A-**8**D, another example is shown where the mechanism **600** is attachable and detachable from the rear cap **220** and/or body **200** by hand in the surgical environment, but where the whole unit **100**/**600** may still be advanced together along the surgical guide wire. Then when the device **100** is at a desired position, the mechanism **600** may be detached from the device **100** while both are still on the wire so the mechanism **600** may then be withdrawn and the device **100** left in place on the wire. FIG. **8**A is a front isometric view, FIG. **8**B is a front isometric view but in an exploded state to show separation of the couplable components, FIG. **8**C is a side orthogonal view, and FIG. **8**D is a top orthogonal view. The devices **100**, **600** according to FIGS. **8**A-**8**D may therefore be the same as other example embodiments above save for the mechanism **600** and one or more portions of the housing **105** being attachable and detachable from each other on the fly.

[0105] For attachment and detachment, a distal portion of the rear cap **220** may have a female mating element **800** configured to engage a male mating element **810** on a distal front end portion of the mechanism **600** via snap fit. This in turn allows the device **100** to be pulled off/detached from the mechanism **600** and reattached/pushed back on to the mechanism **600** on the fly in the surgical environment, using only the physician's hands.

[0106] Now in reference to FIGS. **9**A-**9**I, these figures show another example medical device **910** consistent with present principles. FIG. **9**A is a front isometric view, FIG. **9**B is a rear isometric

view, FIG. **9**C is a top orthogonal view, FIG. **9**D is a side orthogonal view, FIG. **9**E is a bottom orthogonal view, FIG. **9**F is a front orthogonal view, FIG. **9**G is a rear orthogonal view, FIG. **9**H is an exploded view, and FIG. **9**I is a cross-sectional view. The device **910** per these figures may be the same as the device **100** described above, save for the following differences.

[0107] Specifically, rather than a slider release mechanism **160** as described above, the release mechanism per this example implementation may include a lever/tab **900** coupled to the plate **250**. For example, the lever **900** may be made integral with the plate **250** and, as such, may be made of the same material as the plate itself. The lever **900** may be manipulable to move the plate **250** about the fulcrum **300** to counteract the spring bias from the spring **230** and permit withdrawal of the surgical guide wire **115** from the third aperture **260** through the first aperture **120**. As shown, the distal top portion of the lever may be circular, though other shapes may also be used. Thus, a physician may pull the lever back away from the nose cap **210** according to the longitudinal axis **110** to release the binding action the aperture **260** creates on the wire **115** by aligning the third plane of the plate **250** closer to vertical/perpendicular to the longitudinal axis **110**, freeing up the wire **115** to withdraw the device **910** from the wire **115**.

[0108] Beyond the slider **160** and lever **900**, as another example release mechanism may be an element that connects to the body **200** at a pivot point with an axis of rotation perpendicular to the longitudinal axis **110** of the device **100** to rotate up and down the housing. When rotated toward the plate **250** the element slides against and pushes on the plate **250** causing the plate **250**to rotate. This motion will release the binding action the aperture **260** creates on the wire **115** by aligning the third plane of the plate **250** closer to vertical/perpendicular to the longitudinal axis **110**, freeing up the wire **115** to withdraw the device **100** from the wire **115**.

[0109] Continuing the detailed description in reference to FIGS. **10**A-**10**I, these figures show another example device **1010**. FIG. **10**A is a front isometric view, FIG. **10**B is a rear isometric view, FIG. **10**C is a top orthogonal view, FIG. **10**D is a side orthogonal view, FIG. **10**E is a bottom orthogonal view, FIG. **10**F is a front orthogonal view, FIG. **10**G is a rear orthogonal view, FIG. **10**H is an exploded view, and FIG. **10**I is a cross-sectional view. The device **1010** per these figures may be the same as the device **100** described above, save for the following differences.

[0110] Specifically, no release mechanism may be included on the device **1010** per this example implementation. Instead, the physician may simply remove the wire **115** with the device **1010** still attached to it when a desired bone and/or plate alignment is obtained so that permanent, larger holes may then be bored into the bone. Or the wire may simply be cut in front of the device **1010** and proximal to the patient to remove the device **1010**.

[0111] Now in reference to FIGS. **11**A-**11**D, these figures show another example device **1110**. FIG. **11**A is a front isometric view, FIG. **11**B is an exploded view, FIG. **11**C is a side orthogonal view, and FIG. **11**D is a cross-sectional view. The device **1110** per these figures may be the same as the device **100** described above, save for the following differences.

[0112] Specifically, no telescoping members at the front are included on the device **1110**, nor is any release mechanism. Rather, a front aperture **1100** is included and may be similar to the aperture **120** except for being made integral with the rigid body **1120** of the device's housing. Note here that the front of the device **1110** may be flat as shown, or rounded in other examples.

[0113] Moving on to FIG. **12**, this figure shows an innovative threaded lag wire **1200** that may be used with the devices **100**, **600**, etc. described above. As shown in FIG. **12**, the wire **1200** may include a first segment **1210** that may be cut by a physician to a desired length. The segment has a first diameter that is less than a second diameter of a threaded second segment **1220** of the wire **1200**. Also note that the segment **1220** has a pointed distal tip **1230**.

[0114] Thus, the threads on the segment **1220** may be extended through provisional holes in the patient's bone to capture a far piece of the bones and/or plates that are being aligned together. The threads and larger diameter of the segment **1220** may thus help create compression force on one end of the aligned bones/plates, while the devices **100**/**600** create compression force on the other

end of the aligned bones/plates. In some examples, ridges that circumscribe the outside of the segment **1220** in respective planes perpendicular to the longitudinal axis of the wire **1200** may be used in lieu of screw-type threads that extend down the segment **1220** for even greater bone purchase/engagement.

[0115] Turning to FIG. **13**, additional guide wire examples **1300** are shown that may be used consistent with present principles. Among these guide wire examples are olive wires **1310**. The diameters of these flexible wires **1300** (equivalently, rigid guide pins) may be appreciated relative to the dime **1320** shown. Also note that some of the wires **1300** may be threaded while others are not. Also note that the olive wires **1310** may be used, where the olives **1330** may provide compression force at one end of the bone alignment while the device **100** may provide compression force at the other end of the bone alignment.

[0116] Now in reference to FIG. **14**, an example method is demonstrated in flow chart format for surgically using a medical device (such as the device **100**) consistent with present principles. Beginning at step **1400**, the method includes initially aligning various patient bones and/or surgical plates for fixation together consistent with present principles. The method then moves to step **1410** where guide wire(s) (provisional) are bored through the bone(s) according to the desired alignment.

[0117] Then at step **1430**, the guide wire and the devices **100**/**600** may be used to provide compression force to secure the bone segments and/or to secure one or more plates to the bone segments, maintaining the alignment. For example, a free end of the wire may be fed through the first aperture **120**, then through the aperture **260**, and then through the aperture **130**. The device **100** may then continue to be advanced/slid along the wire as desired using the mechanism **600** (or by hand) until the device **100** is compressed against one side of the aligned bone structure. Yet owing to the oblique angle of the aperture **260** relative to the longitudinal axis of the device **100** as described above, the device **100** cannot be withdrawn or unintentionally slide off the opposite way along the wire save for using one of the release mechanisms described above (e.g., slider **160** and/or lever **900**).

[0118] Then at step **1440** the physician may verify the intended alignment of the bones and/or plates with the devices **100**/**600** holding the alignment in place (e.g., on one side of the aligned bones while the segment **1220** of the wire **1200** helps maintain the alignment on the other side of the aligned bones/plates). The process may then flow to step **1450** where the devices **100**/**600** and/or guide wire may be removed from the patient. Also at step **1450**, the surgical procedure may be completed with bone/plate alignment verified by drilling permanent holes in the bone(s) and performing permanent fracture reduction. This last step might occur, for example, after one or more alignment adjustments are performed as desired, using the devices **100**/**600** in the process.

[0119] It may thus be appreciated according to FIG. **14** that the medical device and wire may be used to maintain alignment of a first bone with another object (e.g., second bone and/or plate) during the surgical procedure.

[0120] FIG. **15** shows an example method in flow chart format for manufacturing a medical device, such as the device **100** and/or mechanism **600**, consistent with present principles. Beginning at step **1500**, the housing(s) may be manufactured, such as through injection molding, three-dimensional (**3**D) printing, computer numerical control (CNC) manufacturing, and/or other methods. Thereafter, step **1510** may be performed where the internal components of the device(s) may be manufactured using similar methods. Then at step **1520** manufacturing may be completed, such as through assembling all the parts together for shipping, vending, providing, etc.

[0121] Now in reference to FIG. **16**, this figure shows an example method in flow chart for providing a medical device consistent with present principles. Thus, note that the process flow of FIG. **16** may be used for vending or otherwise providing the medical device through the channels of commerce and ultimately to a medical professional.

[0122] Thus, the method includes, at step **1600**, providing a housing with an elongated body. The housing defines a longitudinal axis. The housing includes a first end portion and a second end

portion. The first end portion includes a first aperture. The second end portion includes a second aperture. The first aperture has a first height and first width establishing a first plane, and the second aperture has a second height and a second width establishing a second plane.

[0123] The method of FIG. **16** also includes, at step **1610**, providing a first element disposed within the housing (e.g., plate or other assembly with an aperture like the third aperture **260**). The first element therefore includes the third aperture. The third aperture has a third height and a third width establishing a third plane. The third plane is oblique with respect to the longitudinal axis while the first element is under bias from a second element in the housing. The first, second, and third apertures are at least partially aligned for a wire to concurrently extend through the first, second, and third apertures while the first element is under bias from the second element. The bias is toward the first end portion. The second element configured in the housing to impose the bias on the first element at a first area of the first element to help maintain the oblique angle of the third plane with respect to the longitudinal axis and to impede withdrawal of the wire from the third aperture toward the first aperture while the wire extends through the third aperture. A second area of the first element is configured within the housing to rest against a fulcrum within the housing. The first element is configured within the housing to rotate during advancement of the wire through the third aperture from the direction of the first aperture due to friction force during the advancement between the wire and one or more first element portions around the third aperture.

[0124] Continuing the detailed description in reference to FIGS. **17**-**20**, these figures show example use cases for the devices **100**/**600** consistent with present principles to create axial pressure on bones and/or plates along the axis of the surgical guide wire itself.

[0125] Beginning first with FIG. **17**, respective devices **100** are shown as advanced along respective wires **115** to compress against a surgical plate **1700** that itself is positioned up against a patient's bone **1710**. If desired, a surgical tool **1720** may also be positioned against the plate **1700** to help maintain alignment. Thus, according to this example the devices **100** may provide a relatively slight one-sided axial reduction force, no additional surgical clamp being used, once slid down the wire **115** to keep the plate from moving during installation/permanent fixation.

[0126] FIG. **18** shows another example. Here, respective devices **100** are again shown as advanced along respective wires **115** to compress against a surgical plate **1800** that itself is positioned up against a patient's bone **1810**. A surgical clamp **1820** is also used to compress a respective device **100** on one side of the aligned bone(s)/plate with the other side of the aligned bone(s)/plate. This provides relatively significant axial reduction force to reduce the plate **1800** to the bone **1810** with the clamp **1820**.

[0127] Turning to FIG. **19**, yet another example is shown. Here, respective devices **100** are again shown as advanced along respective wires **115** to compress against a surgical plate **1900** that itself is positioned up against a patient's bone **1910**. Note that one device **100** is shown being used by itself, while another device **100** is shown as advanced along the respective guide wire **115** using the mechanism **600** before the mechanism **600** is withdrawn from the wire **115** (leaving the device **100** advanced by the mechanism **600** in place and locked along the wire **115** for compression against the plate **1900**). This example therefore demonstrates a higher one-sided axial reduction force (no clamp being used) to reduce the plate **1900** to the bone **1910**, and/or to capture and temporarily reduce a bone fragment through the plate **1900**.

[0128] FIG. **20** shows still another example. Here, respective devices **100** are shown facing each other as advanced from opposing sides of a same wire **115**, with one of the devices **100** advanced to compress a plate **2000** to one side of a bone structure **2010** and the other device **100** advanced on the other side of the bone structure to compress against an external portion of the structure **2010** itself. This allows for relatively significant axial reduction force to reduce the plate **2000** to the bone(s) **2010** with two sliding pill/tack devices **100**.

[0129] Moving on from FIG. **20**, note that in some specific examples a kit including one or more of the devices/mechanisms disclosed above (and/or sub-components of those devices) may be

manufactured, vended/provided, and/or used during a fracture reduction procedure or other type of surgical procedure consistent with present principles. Surgical alignment wires of one or more types disclosed herein may also be provided as part of the kit. The surgeon may thus decide on the fly which wire/device combination from the kit to use, depending on whatever circumstances the surgeon might encounter during surgery.

[0130] Components included in one embodiment can be used in other embodiments in any appropriate combination. For example, any of the various components described herein and/or depicted in the Figures may be combined, interchanged, or excluded from other embodiments.

[0131] The term “a” or “an” in reference to an entity refers to one or more of that entity. As such, the terms “a” or “an”, “one or more”, and “at least one” can be used interchangeably herein.

[0132] “A system having at least one of A, B, and C” (likewise “a system having at least one of A, B, or C” and “a system having at least one of A, B, C”) includes systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.

[0133] It is to be understood that whilst present principals have been described with reference to some example embodiments, these are not intended to be limiting, and that various alternative arrangements may be used to implement the subject matter claimed herein. Accordingly, while particular techniques and devices are herein shown and described in detail, it is to be understood that the subject matter which is encompassed by the present application is limited only by the claims.

Claims

1. A medical device, comprising: means for advancing a surgical guide wire engagement device along a surgical guide wire; and means for holding the surgical guide wire engagement device in place along the surgical guide wire, comprising: a first element that engages the surgical guide wire to hold the surgical guide wire engagement device in place along the surgical guide wire; and a second element that provides force to reduce and absorb backlash from engagement of the surgical guide wire engagement device with the surgical guide wire to hold the surgical guide wire engagement device in place along the surgical guide wire, the second element being different from the first element.

2. The medical device of claim 1, wherein the means for advancing the surgical guide wire engagement device along the surgical guide wire comprises aligned openings in the surgical guide wire engagement device.

3. The medical device of claim 2, wherein the second element comprises first and second telescoping members that slide with respect to each other according to a longitudinal axis of the surgical guide wire engagement device.

4. The medical device of claim 3, wherein the first telescoping member is configured to slide toward a plate in the surgical guide wire engagement device to compress a spring that exerts the force.

5. The medical device of claim 4, wherein the spring is a first spring, and wherein the first element comprises a plate disposed within a housing of the surgical guide wire engagement device, the plate configured to remain oblique with respect to the longitudinal axis while the plate is under spring bias from a second spring in the housing to hold the surgical guide wire engagement device in place along the surgical guide wire.

6. The medical device of claim 1, comprising: means for releasing the surgical guide wire engagement device from the surgical guide wire.

7. The medical device of claim 1, comprising: means for mechanically advancing the surgical guide wire engagement device along the surgical guide wire.

8. A method comprising: providing means for advancing a surgical guide wire engagement device

along a surgical guide wire; and providing means for holding the surgical guide wire engagement device in place along the surgical guide wire, the means for holding the surgical guide wire engagement device in place along the surgical guide wire comprising: a first element that engages the surgical guide wire to hold the surgical guide wire engagement device in place along the surgical guide wire; and a second element that provides force to absorb backlash from engagement of the surgical guide wire engagement device with the surgical guide wire to hold the surgical guide wire engagement device in place along the surgical guide wire, the second element being different from the first element.

9. The method of claim 8, wherein the means for advancing the surgical guide wire engagement device along the surgical guide wire comprises aligned openings in the surgical guide wire engagement device.

10. The method of claim 8, wherein the second element comprises first and second telescoping members that slide with respect to each other according to a longitudinal axis of the surgical guide wire engagement device.

11. The method of claim 10, wherein the first telescoping member is configured to slide toward a plate in the surgical guide wire engagement device to compress a spring that exerts the force.

12. The method of claim 11, wherein the spring is a first spring, and wherein the first element comprises a plate disposed within a housing of the surgical guide wire engagement device, the plate configured to remain oblique with respect to the longitudinal axis while the plate is under spring bias from a second spring in the housing to hold the surgical guide wire engagement device in place along the surgical guide wire.

13. The method of claim 8, comprising: providing means for releasing the surgical guide wire engagement device from the surgical guide wire.

14. The method of claim 8, comprising: providing means for mechanically advancing the surgical guide wire engagement device along the surgical guide wire.

15. A medical device, comprising: one or more structural components configured to hold a surgical guide wire engagement device in place along a surgical guide wire, the one or more structural components comprising: one or more first structural components that are structurally configured to provide force to absorb backlash and help hold the surgical guide wire engagement device in place along the surgical guide wire, the backlash being from engagement of the surgical guide wire engagement device with the surgical guide wire.

16. The medical device of claim 15, comprising: one or more second structural components that are structurally configured to engage the surgical guide wire to hold the surgical guide wire engagement device in place along the surgical guide wire, the one or more second structural components being different from the one or more first structural components.

17. The medical device of claim 15, comprising: one or more second structural components that are structurally configured to advance the surgical guide wire engagement device along the surgical guide wire.

18. The medical device of claim 15, wherein the one or more first structural components that provide the force are structurally configured to reduce wire travel within the surgical guide wire engagement device due to the surgical guide wire being cinched within the surgical guide wire engagement device to hold the surgical guide wire engagement device in place along the surgical guide wire.

19. The medical device of claim 18, comprising: one or more second structural components that are structurally configured to help maintain a compression force along the surgical guide wire between bone fragments and/or plates for ascertaining proper bone and/or plate alignment during fracture reduction or other bone repair.

20. The medical device of claim 15, comprising: one or more second structural components that are structurally configured to mechanically advance the surgical guide wire engagement device along the surgical guide wire.