

ILLUMINATED ENDOSCOPIC PEDICLE PROBE WITH REPLACEABLE TIP

This application claims priority from US application serial number , filed
5 December 27, 2012, which claims the benefit of US provisional patent application
serial number 61/647,747, filed May 16, 2012, incorporated in full herein by reference.

Technical Field:

This invention relates generally to surgical instruments. More specifically, the
10 invention relates to a pedicle probe for use in forming holes in a vertebral pedicle in
preparation for pedicle screw insertion. According to one feature of the invention the
probe incorporates at least one endoscope to enable the surgeon to see the area being
treated. According to another feature the probe has a light to illuminate the area being
treated, and according to a further feature the probe has a replaceable tip on its distal
15 end. According to a still further feature the probe has a channel for directing a flushing
fluid to the area being treated to maintain a clear field of vision for the endoscopic
camera. The probe of the invention may have any one or any combination of these
features.

20 Background Art:

It is sometimes necessary to perform surgery on the spine in order to repair
trauma, correct a deformity, or alleviate the effects of disease. Spinal fusion or
stabilization is one procedure that may be employed to treat these conditions.
According to one source, at the present time there are approximately 30 million spine
25 procedures performed globally each year, including approximately 400,000 cervical
and lumbar fixations performed in the US.

Spinal fusion may be accomplished by insertion of screws into the pedicle to
stabilize a spinal segment. The pedicle is a dense, stem-like structure projecting from
the posterior of a vertebra, and there are two pedicles per vertebra that connect to other
30 structures. Since the pedicle is the strongest point of attachment of the spine,

significant forces can be applied to the spine without failure of the bone-to-metal connection.

To insert pedicle screws, a long, thin, metal probe is inserted through the pedicle and into the vertebral body, forming a hole for reception of the screw. Conventional
5 pedicle probes may be straight or curved, and comprise an elongate solid metal shaft with an enlarged hand grip on the proximal end. The probe may have a shaped distal end adapted for forming a hole through the pedicle, or a separate awl or reamer may first be used to form a hole through the pedicle, and the probe then inserted into the cancellous bone of the pedicle and into the vertebral body to develop a path for the
10 screw.

A variety of probes are known in the prior art, including the so-called gear shift pedicle probe and the Fox pedicle probe. The gear shift probe has a round head on its proximal end, whereas the Fox probe has a flat disc-shaped head on its proximal end.

Conventional modalities used to approximate or simulate screw placement are
15 indirect, and include fluoroscopic guidance and frameless stereotactic guidance. Approximations of the pedicle and surrounding vital structures are obtained from a CT scan or MRI done prior to surgery.

Proper positioning of a conventional probe depends to an extent upon tactile feel. For instance, advancement of the probe should be smooth and consistent. A
20 sudden plunge suggests breaking out of the pedicle laterally, and an increase in resistance indicates abutment against the pedicle or vertebral body cortex.

These conventional modalities require a steep learning curve, and improper or inaccurate manipulation of the probe and placement of the pedicle screw can result in caudal or medial penetration of the pedicle cortex and dural or neural injury.

25 With conventional pedicle probes there is no direct way to confirm that the hole was made within the pedicle and that the screw will be placed completely inside the pedicle. Surrounding structures can be injured if a portion of the screw is placed outside of the pedicle. There can be nerve root injury, epidural vessel injury, or spinal fluid leakage caused by a misplaced screw.

Applicant's earlier US patent, number 6,855,105, discloses an endoscopic pedicle probe having a camera at its distal end connected with an endoscopic monitor via a fiber optic bundle extending through the probe to provide the surgeon with a view of the area being treated, thus overcoming many of the shortcomings of conventional
5 pedicle probes.

Notwithstanding the advantages of applicant's earlier pedicle probe, illumination of the area being treated would greatly enhance use of the probe. Currently, there are no pedicle probes having any means to illuminate the pedicle.

Additionally, the distal tip of the probe can become worn or damaged during
10 use, rendering the whole instrument unusable or reducing its usefulness. Further, in some instances a tip having different characteristics may be desired. A replaceable tip enables this to be achieved without having to replace the entire instrument.

Further, body fluids and debris can accumulate at the area being treated, blocking or degrading the view provided by the endoscope. It would be desirable to
15 have a means to flush these fluids and debris away from the area being treated to maintain a clear field of view for the endoscope camera.

Accordingly, there is need for a system and method for insertion of pedicle screws which eliminates the guesswork and error-prone modalities of the prior art. In particular, there is need for a system which provides the surgeon with direct visual
20 confirmation during the surgical procedure that the pedicle probe is in the right position for forming a hole for proper placement of the pedicle screw. Further, there is need for a pedicle probe having a removable distal tip that can be replaced when necessary or desired. Still further, there is need for a pedicle probe having means for illuminating the area being treated. Additionally, there is need for a pedicle probe having means for
25 directing a fluid to the area being treated to remove body fluids and debris that might otherwise obscure the area.

Summary of the Invention:

The present invention comprises a pedicle probe having means associated with
30 it to enable the surgeon to directly confirm the location of the probe during a surgical

procedure. More specifically, the invention comprises a pedicle probe which provides the surgeon with a visual indication during a surgical procedure of the position of the probe relative to the pedicle and surrounding structure, and which, in accordance with one aspect of the invention, has means to illuminate the pedicle. In accordance with
5 another aspect of the invention the distal tip of the probe is replaceable and may be disposable. In a further aspect of the invention the probe has means associated with it to flush the area being treated to wash away body fluids and debris that would otherwise obscure the field of vision.

In particular, the probe of the invention is an endoscopic probe having an
10 elongate shaft with a reduced diameter tip on its distal end. A camera at the distal end is connected with an endoscopic monitor via a fiber optic bundle extending through the shaft, and depending upon the positioning of the camera and the lens employed, the probe of the invention affords the surgeon direct views of the area being treated, ranging from 0° to 90° relative to the longitudinal axis of the probe shaft, depending
15 upon the positioning of the endoscope camera.

In a preferred embodiment a light is associated with the probe for illuminating the area being treated.

In another preferred embodiment, the distal tip can be threaded or otherwise securely removably attached to the forward or distal end of the shaft so that the tip can
20 be replaced when worn or damaged or when a tip having different characteristics is desired.

In a further preferred embodiment, means is provided on the probe for flushing the area being treated with a fluid, such as, e.g. saline, to remove body fluids and debris that might otherwise obscure the view.

25 In one example of the invention, a Fox probe is modified to have a hollow shaft and a small endoscope is placed in the hollow shaft, with a camera positioned at the distal end and connected via a fiber optic bundle with an endoscopic monitor to afford either a 0°, a 45° or a 90° view, depending upon the lens employed and the positioning of the camera.

The endoscopic pedicle probe of the invention puts the surgeon “in the pedicle” with the use of endoscopy. The positioning of the probe can be directly and accurately determined during surgery, and there is no question as to whether the screw will be too medial, lateral, cranial, caudal, or deep. The surgeon will know if the wall of the pedicle has been breached, and to what extent. He or she can then decide to use the planned trajectory even if there is a small breach of the pedicle wall. The probe of the invention provides the surgeon with knowledge of how much of an intrusion exists, and he or she can ascertain if critical structures will be in danger from screw placement. The surgeon can also avoid parallax that may cause errors when using fluoroscopic guidance.

Further, a probe must be used in any event to perform spinal fusions, and the probe of the invention will not represent an additional instrument needed for pedicle screw placement. Accordingly, there will be no additional costs or equipment needed to perform the standard spinal fusion.

The probe of the invention can be utilized in the cervical spine for lateral mass screw placement, pedicle screw placement, or trans-articular screw placement. It can be used in the thoracic, lumbar, and sacral spine for pedicle screw placement and trans-laminar screw placement, and can be used in standard open spine fusion or in minimally invasive percutaneous spine fusion.

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Brief Description of the Drawings:

The foregoing as well as other objects and advantages of the invention will become apparent from the following detailed description when considered in conjunction with the accompanying drawings, wherein like reference characters designate like parts throughout the several views, and wherein:

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FIG. 1 is a somewhat schematic perspective view of an endoscopic pedicle probe according to the invention, in combination with an endoscopy monitor.

FIG. 2 is a side view in elevation of a conventional pedicle probe on which the present invention can be based.

FIG. 3 is a longitudinal sectional view of a first embodiment of endoscopic pedicle probe according to the invention.

FIG. 4 is an enlarged, fragmentary, longitudinal sectional view of the distal end of the endoscopic pedicle probe of FIG. 3, depicting a 90° lens orientation.

5 FIG. 5 is a view similar to figure 4, but showing a 45° lens orientation.

FIG. 6 is a view similar to figure 5, but showing a 0° lens orientation.

FIG. 7 is an axial view of a pedicle.

FIG. 8 is a sagittal view of a pedicle.

FIGS. 9 and 10 are fragmentary perspective views depicting how a pedicle
10 probe is used to form a hole in a pedicle.

FIGS. 11-14 are somewhat schematic views depicting the progressive steps in forming a hole in the pedicle using the pedicle probe.

FIG. 15 is an enlarged fragmentary isometric view of the distal end of one
15 embodiment of pedicle probe according to the invention, showing light means for illuminating the pedicle.

FIG. 16 is an enlarged fragmentary isometric view of the distal end of one embodiment of pedicle probe according to the invention, showing a removable tip.

FIG. 17 is a side view in elevation of another embodiment of pedicle probe according to the invention.

20 FIG. 18 is a side view in elevation of the probe of FIG. 17, taken at 90 degrees to the view in FIG. 17.

FIG. 19 is an end view of the probe of FIGS. 17 and 18, taken in the direction of the arrow 19 in FIG. 17.

FIG. 20 is an end view of the probe of FIGS. 17 and 18, taken in the direction of
25 the arrow 20 in FIG. 17.

FIG. 21 is an enlarged fragmentary view in elevation of the distal end of the shaft and the tip on the distal end in the embodiment of probe shown in FIGS. 17-20.

FIG. 22 is a further enlarged fragmentary end view of the probe of FIG. 21, taken in the direction of the arrow 22 in FIG. 21.

FIG. 23 is a slightly enlarged fragmentary side view in elevation of the area indicated generally by the bracket 23 in FIG. 21.

5 FIG. 24 is a sectional view taken along line 24-24 in FIG. 19.

FIG. 25 is a sectional view taken along line 25-25 in FIG. 19.

FIG. 26 is a fragmentary longitudinal sectional view of another embodiment of pedicle probe according to the invention.

FIG. 27 is a fragmentary top isometric view of the probe of FIG. 26.

10 FIG. 28 is an end view in elevation of the probe of FIG. 26, looking from the left hand side of FIG. 26.

FIG. 29 is a side view, shown partially in section and partially in elevation, of a further modified probe according to the invention, wherein channels are formed in the outer surface of the probe shaft and feeds for the light, camera and flushing liquid are
15 placed in these channels, with a surrounding sleeve placed over the shaft to secure the parts in place.

FIG. 30 is a transverse sectional view taken long line 30-30 in FIG. 29.

FIG. 31 is a transverse sectional view taken long line 31-31 in FIG. 29.

FIG. 32 is an exploded isometric view, with portions broken away, of the probe
20 and sleeve of FIGS. 29-31.

FIG. 33 is a fragmentary enlarged sectional view of the distal end of a further embodiment of the invention wherein a removable tip is held in place by a set screw and is aligned in proper position by a keyway.

FIG. 34 is a transverse view in section taken along line 34-34 in FIG. 33.

25 FIG. 35 is a transverse view in section taken along line 35-35 in FIG. 33.

FIG. 36 is a longitudinal sectional view of a further embodiment of the invention, taken along line 36-36 in FIG. 37, wherein two endoscopes are associated

with the probe, and a light means and saline flush means are provided for illuminating the area being treated and for flushing away debris to maintain a clear field of view.

FIG. 37 is an enlarged end view looking in the direction of the arrow "37" in FIG. 36.

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Best Modes for Carrying Out the Invention:

Referring more specifically to the drawings, a conventional Fox pedicle probe is depicted at **10** in figure 2. The probe has a disc-shaped head **11** on its proximal end that is about two inches in diameter, and a solid metal shaft **12** projecting from the center of one side thereof. A reduced diameter tip **13** on the distal end of the shaft is configured to act as a reamer, i.e., it may have a fluted configuration as found on drill bits. In use, a surgeon places the disc-shaped head **11** in the palm of his or her hand, with the shaft extending forwardly. The tip is then pushed against the pedicle while the probe is being rotated back and forth about the longitudinal axis of the shaft to form a hole in the pedicle for reception of a pedicle screw. See, for example, figures 9-14.

In the specific embodiment illustrated and described herein, the pedicle probe **20** of the invention, as shown in figures 1 and 3-15, is based on the Fox pedicle probe of figure 2. However, it should be understood that the probe **20** could be based on other commercially available probes, or could embody a completely new design. The disc-shaped head **11'** of the probe **20** has an opening **21** formed in it for receipt of a fiber optic cable or endoscope **22**, which is connected with a suitable conventional monitor **23**. Similarly, the shaft **12'** has a bore **24** formed through its length for receipt of the fiber optic cable or endoscope **22**, which terminates in the tip **13'** at a lens **25**. As in conventional pedicle probes, such as the Fox pedicle probe, the tip **13'** is adapted to penetrate the hard bony tissue of a vertebral pedicle to form a hole for reception of a pedicle screw.

As shown in the drawings, the tip has a substantially uniform diameter through a portion of its length, and terminates in a sharpened point. The diameter of the tip is approximately the same as, or slightly smaller than, the diameter of a pedicle screw to be inserted in the hole formed with the probe, and will form an elongate hole having a

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uniform diameter for secure engagement with a screw inserted in the hole. The tip has a hardness and configuration to act as a reamer, and preferably has a fluted configuration as incorporated, for example, in a conventional Fox pedicle probe, to facilitate penetration of the probe through the hard bony tissue.

5 As shown in figures 4, 5 and 6, respectively, the tip **13'** or **13''** or **13'''** can be configured to position the lens **25** for providing a 90° view (FIG. 4), or a 45° forward view (FIG. 5), or a 0° view straight ahead (FIG. 6). Thus, by selection of an appropriate probe, or by appropriate manipulation of a probe, the surgeon can obtain a direct visual indication of the exact position of the probe in the pedicle and of the
10 pedicle itself and surrounding structure. As depicted in these figures, the lens is placed rearwardly of the distal point of the end to protect it when the probe is pressed against and pushed through hard bony tissue. An obturator, not shown, may be provided to close the opening through the side of the tip and protect the lens **25**.

 A second embodiment of probe **30** is shown in figure 15. In this modification a
15 suitable light **31** is placed at the distal end of the shaft **12'** adjacent the base end of the tip **13'**. The light **31** is connected via fiber optics **32** or other suitable means extended through the shaft **12'** and connected with a suitable light source (not shown) external of the probe, and may be positioned to face axially forwardly of the shaft, as shown in figure 15, or at an angle to the longitudinal axis of the probe. In use, the light
20 illuminates the pedicle in the area being treated to provide the surgeon with enhanced visibility of the area as observed through the lens **25** of the endoscope **22**.

 Figure 16 depicts a third embodiment **40** of pedicle probe in which the tip **41** is removable. In the example shown the removable tip has a threaded connection **42** with the shaft **12''**, but other means (not shown) of securely removably attaching the tip **41**
25 to the shaft could be utilized. The removable tip may be made of any suitable material, including carbon fiber, and enables tips with different designs to be used on the probe and also enables the tip to be replaced if it becomes worn or damaged during use, thereby avoiding the necessity of having to replace or dispose of the entire probe. The removable tip may be used without either the endoscope of figures 3-6 or the light of
30 figure 15, or it may be used in combination with either or both the endoscope and light, shown as optional features in broken lines at **25** and **31** in figure 16.

Figures 7 and 8 are axial and sagittal views, respectively, of a pedicle **P**, and figures 9-14 are schematic illustrations of how a probe **20** might be used to form a hole in the pedicle. Thus, and as seen especially in figures 10-14, the probe is pushed through the pedicle to form a hole for reception of a pedicle screw (not shown).

- 5 Depending upon the structure of the tip **13'** the probe also may be rotated back and forth to assist in forming the hole. Great care must be exercised to insure that the probe stays within the pedicle and does not break through the wall, or does not go too deep.

A fourth embodiment **50** of pedicle probe according to the invention is shown in FIGS. 17-25. The probe **50** has an enlarged generally disc-shaped head **51** on its proximal end for grasping by the surgeon as in the previous embodiments, an elongate reduced diameter shaft **52** projecting from the center of one side of the head, and a further reduced diameter tip **53** extending coaxially from the distal end of the shaft. The head comprises a circumferential rim **54** connected to the proximal end of the shaft **52** by at least two spokes **55A** and **55B** that join the rim with a hub **56** on the proximal end of the shaft. The outer surface of the rim is longitudinally fluted at **57**, and two circumferentially spaced recesses **58** and **59** are formed in the upwardly facing proximal end surface **60** of the rim. As used herein, "upwardly facing" refers to the orientation when the probe is in its operative position during use. In the particular construction shown, the recesses are in alignment with respective flutes **57** and are circumferentially spaced apart 90 degrees. Two bores **61** and **62** are formed longitudinally through the hub and shaft in positions oriented respectively on a radius extending through a respective recess **58** or **59**. One of the bores **62** exits the distal end of the shaft in an axially forwardly facing shoulder **63** between the base end of the tip and the adjacent end of the shaft. The other bore **61** ends in a slot **64** formed in the side of the shaft at its distal end and extending angularly at an angle β of 16 degrees relative to the longitudinal axis of the shaft into the base end of the tip. A bore **65** extends from the slot and diagonally through the tip to exit an opposite side of the tip, providing a view extending over an angle α of 74 degrees.

A fifth embodiment **70** of pedicle probe according to the invention is shown in figures 26-28. In this embodiment, the proximal end or head **71** of the probe has a central opening **72** extending inwardly from its axially upwardly facing surface **73**, and

a plurality of bores **74**, **75** and **76** extend longitudinally through the shaft **77** from the base of the opening. A radial notch **78** in the axially upwardly facing surface connects the central opening with the outer circumference of the head. An endoscope **22**, light **31**, and conduit **79** for conveying a flushing fluid to the distal end of the probe to
5 remove body fluids and debris from the area being worked on extend through the notch **78** and through the bores **74**, **75** and **76**, respectively. Although not shown in figures 26-28, the bores **74**, **75** and **76** could exit through the shoulder between the base end of the tip and the distal end of the shaft (see, e.g. shoulder **63** in figures 24 and 25), or the endoscope bore could terminate in a slot such as slot **64** seen in figures 21-23. Also
10 not shown in figures 26-28, the tip could be integrally formed with the shaft as seen in figures 17-25 or it could be detachable as seen in figure 16.

A sixth embodiment **80** of pedicle probe according to the invention is shown in figures 29-32. In this form of the invention, rather than extend bores longitudinally through the body of the shaft for containing the endoscope, light and conduit for the
15 flushing fluid, longitudinally extending channels **81**, **82** and **83** are formed in the outer surface of the shaft **84**, and a cylindrical sleeve **85** is positioned in snug relationship over the shaft in enclosing relationship to the channels and the endoscope **22**, light **31** and conduit **79** held therein. As in the previous embodiments, the tip may be integral with the shaft or detachable. Similarly to the embodiment shown in figures 26-28, the
20 head **71'** has a central opening **72'** and the endoscope **22**, light **31** and flushing conduit **79** are fed through a notch **78'** in the end surface of the head.

A seventh embodiment **90** of pedicle probe according to the invention is shown in figures 33-35. In this form of the invention, the tip **91** is detachably secured to the distal end of the shaft **92** by a set screw **93** extended through the side of the shaft and
25 into engagement with the base end **94** of the tip, which is inserted into an axial bore **95** in the distal end of the shaft. Proper rotational positioning of the tip relative to the shaft is achieved by a keyway formed by an axially extending groove or slot **96** in the interior surface of bore **95** and a complementally shaped key **97** on the exterior of the base end
94 of the tip. The tip may be readily detached from the shaft by loosening the set screw
30 and may be used with any of the previous forms of the invention. An endoscope **22** and/or a light **31** and/or a conduit **79** for flushing fluid, all shown in figures 33-35, may

be used in combination with the detachable tip, or the detachable tip may be used without any of these. As seen in figure 35, the outlet for the flushing fluid may have numerous small orifices **98** to provide a “soft” flow of flushing fluid against the area being treated.

5 An eighth embodiment **100** of probe according to the invention is shown in figures 35 and 36. In this embodiment, two endoscopes **101** and **102** are provided in the probe. One of the endoscopes **101** has its camera **103** positioned at the distal end of the tip **104** in a zero degree forwardly facing orientation. The other endoscope **102** has its camera **105** positioned at the distal end **106** of the probe shaft **107** and oriented in a
10 camera window slot **108** to provide about a 70° view looking at the side of the pedicle wall. A bright fiber optic light source **109** is positioned at the distal end of the probe shaft adjacent the window for the camera **105**. The light illuminates the pedicle and surrounding bony structures which will give visualization within the cancellous portion of the pedicle. A saline rinse port **110** also preferably is provided at the distal end of
15 the probe shaft to rinse away debris during use of the probe to keep the field of vision clear.

One example of a suitable endoscopic camera for use in the probe of the invention is the 1.2mm micro camera available from Medigus, Ltd. of Omer, Israel. This camera has a diameter of only 1.2 mm and a length of only 5 mm. It has high
20 quality 100 degree FOV optics and a shielded camera cable with a metal connector as well as a video processor.

In a typical example of a probe made in accordance with the invention the shaft can have a length of about 28 cm and a diameter of from about 6 mm to about 12 mm; the tip can have a length of about 40 mm and a diameter of from 4 to about 5 mm; and
25 the endoscope 22, light 32 and conduit 79 for flushing fluid each can have a diameter of from about 1 mm to about 2 mm. In those embodiments wherein the camera for the endoscope is located adjacent the proximal end of the tip, it can be placed along the tip a distance spaced approximately 6 to 8 mm from where the tip is joined to the end of the shaft, and preferably is oriented at an angle of 45 to 90 degrees relative to the
30 longitudinal axis of the tip. It should be noted that these are exemplary dimensions

only and the probe and its components could have other dimensions as necessary or desirable.

The endoscopic probe of the invention provides the surgeon with an illuminated, direct visual indication of the exact location of the probe and provides for flushing body
5 fluids and debris away from the area being treated, whereby the hole can be formed with accuracy and precision.

While particular embodiments of the invention have been illustrated and described in detail herein, it should be understood that various changes and modifications may be made to the invention without departing from the spirit and intent
10 of the invention as defined by the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A pedicle probe for forming a hole in the hard bony tissue of a vertebral pedicle to receive a pedicle screw, said pedicle probe comprising:
 - an enlarged proximal end for cooperation with the hand of a surgeon using the probe to aid in controlling the probe;
 - 5 an elongate shaft having a longitudinal axis and extending from the enlarged proximal end and terminating in a distal end; and
 - a detachable shaped tip on the distal end of the shaft, said tip having a reduced diameter relative to the shaft and a hardness and configuration adapted to be pushed through a pedicle to form a hole for reception of a pedicle screw, wherein said
 - 10 detachable tip enables a damaged or worn tip to be replaced, or a tip with different characteristics to be employed, without replacing the entire probe.
2. A pedicle probe as claimed in claim 1, wherein:
 - a bore extends longitudinally through the shaft and an endoscope extends through said bore, said endoscope including a camera having a lens positioned to provide a view of an area being treated and said endoscope being connected with an
 - 5 external monitor for conveying a visual image of the position of the tip relative to the area being treated during a surgical procedure, whereby a surgeon is provided with direct visual indication of the exact position of the probe during spinal surgery.
3. A pedicle probe as claimed in claim 2, wherein:
 - a second bore extends longitudinally through the shaft and a light is associated with said second bore to illuminate the area being treated.
4. A pedicle probe as claimed in claim 2, wherein:
 - the tip is fluted like a drill bit, and the lens and an opening for receipt of the lens is positioned in the base of a channel formed between the flutes.

5. A pedicle probe as claimed in claim 2, wherein:

the lens is positioned rearwardly of the distal point of the tip, whereby the lens is protected as the probe is inserted into hard bony material.

6. A pedicle probe as claimed in claim 2, wherein:

the lens is oriented to provide a view at 90° relative to the longitudinal axis of the shaft.

7. A pedicle probe as claimed in claim 2, wherein:

the lens is oriented to provide a forward view at 45° relative to the longitudinal axis of the shaft.

8. A pedicle probe as claimed in claim 2, wherein:

the lens is oriented to provide a straight-ahead forward view.

9. A pedicle probe as claimed in claim 3, wherein:

a third bore extends longitudinally through the shaft and a conduit for a fluid to flush the area being treated extends through said bore to flush body fluid and debris away from the area being treated.

10. A pedicle probe for forming a hole in the hard bony tissue of a vertebral pedicle to receive a pedicle screw, said pedicle probe comprising:

an enlarged proximal end for cooperation with the hand of a surgeon using the probe to aid in controlling the probe;

5 an elongate shaft having a longitudinal axis and extending from the enlarged proximal end to a distal end;

a reduced diameter tip on said distal end, said tip having a hardness and configuration adapted to be pushed through a pedicle to form a hole for reception of a pedicle screw;

10 a first bore extending longitudinally through said shaft and a first endoscope associated with said first bore, said first endoscope including a camera positioned at the distal end of said shaft and being connected with an endoscopic monitor to provide a surgeon with a direct view of the area being treated; and

15 a second bore extending longitudinally through the shaft and a light associated with said second bore to illuminate the area being treated.

11. A pedicle probe as claimed in claim 10, wherein:

5 a third bore extends longitudinally through said shaft and through said tip, and a second endoscope is associated with said third bore, said second endoscope including a camera positioned at the distal end of said tip and being connected with an endoscopic monitor to provide a surgeon with a direct view of the area being treated.

12. A pedicle probe as claimed in claim 11, wherein:

a fourth bore extends longitudinally through said shaft, and a conduit extends through said third bore for conveying a fluid to the area being treated to flush away from the area body fluid and debris that would otherwise obscure the area being treated.

13. A pedicle probe as claimed in claim 12, wherein:

said tip is detachable from said shaft, whereby said detachable tip enables a damaged or worn tip to be replaced, or a tip with different characteristics to be employed, without replacing the entire probe.

14. A pedicle probe as claimed in claim 13, wherein:

said detachable tip is threadably attached to said shaft.

15. A pedicle probe as claimed in claim 13, wherein:

said detachable tip has a base end received in an axial bore in the center of the distal end of the shaft, and a set screw extends through a side of said shaft into engagement with said tip base end to hold the tip in said axial bore.

16. A pedicle probe as claimed in claim 15, wherein:

a coaxial bore in said base end of said tip is in axial alignment with said first bore in said shaft, and said coaxial bore in said base end of said tip connects with an angularly extending diagonal bore opening through a side of said tip, said camera being
5 positioned in said diagonal bore where it exits through the side of said tip.

17. A pedicle probe as claimed in claim 16, wherein:

said second and fourth bores open through the distal end of said shaft in rotationally spaced relationship to one another, said tip being rotationally oriented relative to said shaft so that said light is positioned on the same side of said probe as
5 said diagonal bore and said camera.

18. A pedicle probe as claimed in claim 17, wherein:

a keyway is formed between the base end of said tip and said coaxial bore in said shaft to rotationally orient said tip when it is attached to said shaft so that said light is positioned on the same side of said probe as said diagonal bore and said camera.

19. A pedicle probe for forming a hole in the hard bony tissue of a vertebral pedicle to receive a pedicle screw, said pedicle probe comprising:

an enlarged proximal end forming a head for cooperation with the hand of a surgeon using the probe to aid in controlling the probe;

- 5 an elongate shaft having a longitudinal axis and extending from the enlarged proximal end and terminating in a distal end;

a reduced diameter tip on said distal end, said tip having a hardness and configuration adapted to be pushed through a pedicle to form a hole for reception of a pedicle screw;

- 10 at least one longitudinally extending channel formed in an outer surface of said shaft;

an endoscope extending through said head and through said at least one channel, said endoscope including a camera at the distal end of said shaft; and

- 15 a cylindrical sleeve telescoped over said shaft and over said at least one channel and endoscope positioned therein.

20. A pedicle probe as claimed in claim 19, wherein:

a second longitudinally extending channel is formed in the outer surface of said shaft, and a light means extends through said head and through said second channel to illuminate an area viewed by said endoscope.

21. A pedicle probe as claimed in claim 20, wherein:

a third longitudinally extending channel is formed in the outer surface of said shaft, and a conduit extends through said third channel for conveying a fluid to the area being treated to flush body fluid and debris away from the area.