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(54) **CLEAR VIEW CANNULA**

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(57) **ABSTRACT**

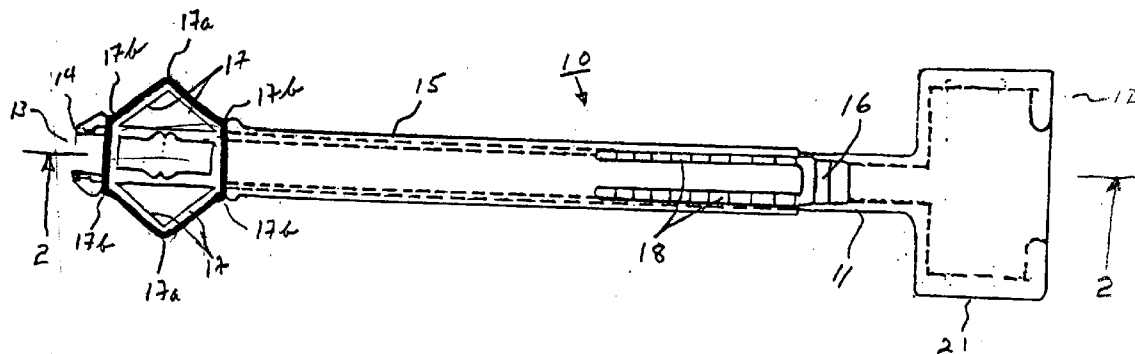
There is disclosed a clear view cannula for use in surgical procedures having a tubular body, a cylindrical sleeve mounted about and slidably secured to the tubular body, and a plurality of shield members secured to the cylindrical sleeve. The cylindrical sleeve is slidably movable relative to the tubular body causing the shield members to expand and deploy such that the shield members retain torn and fragmented soft tissue within an anatomical cavity. Means are provided on the tubular body to co-act with means on the cylindrical sleeve to lock the expanded and deployed shield members and secure the tubular body within an anatomical body.

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Related U.S. Application Data

(62) **Division of application No. 09/293,284, filed on Apr. 16, 1999, now Pat. No. 6,632,197.**



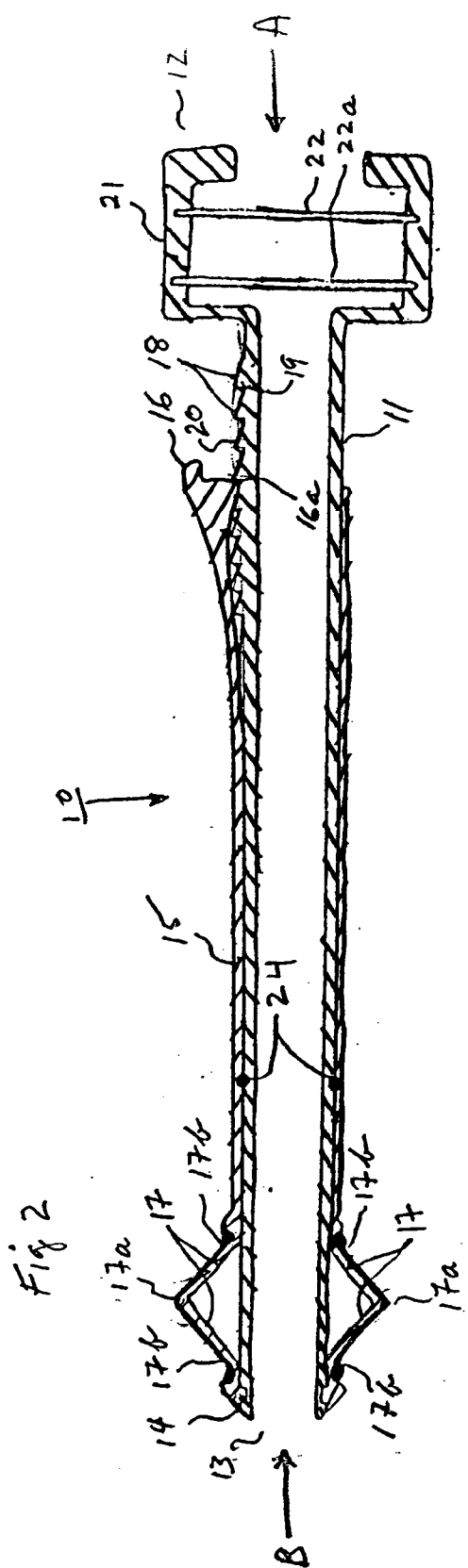
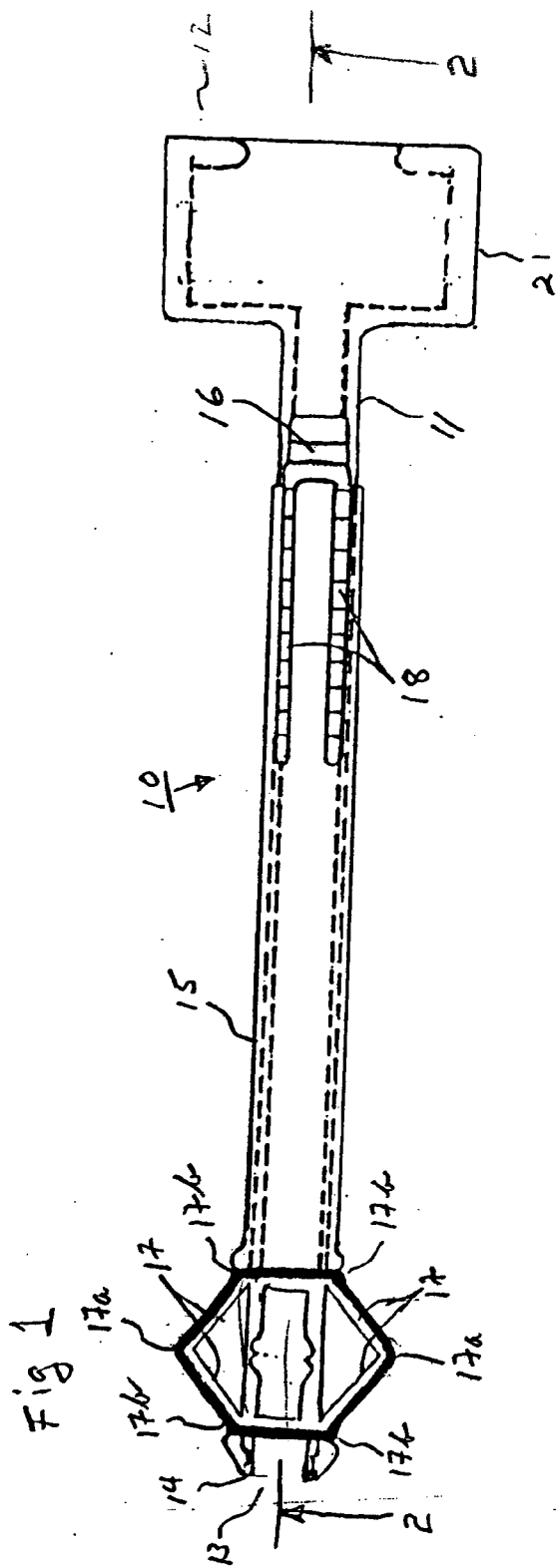


Fig 3

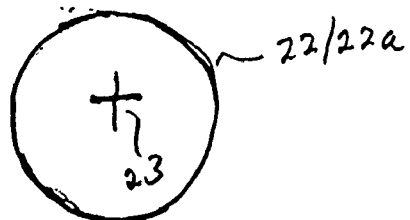


Fig 4

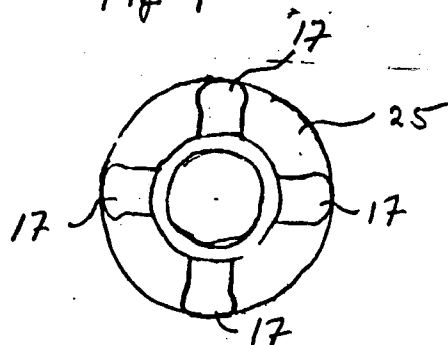


Fig 5

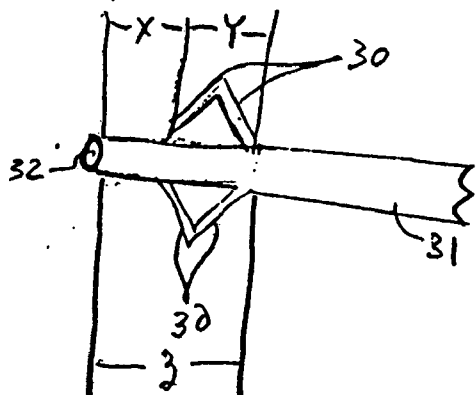


Fig 6

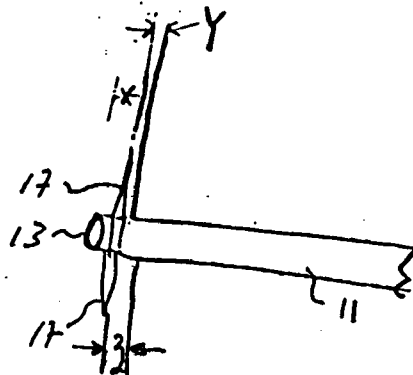


Fig 7

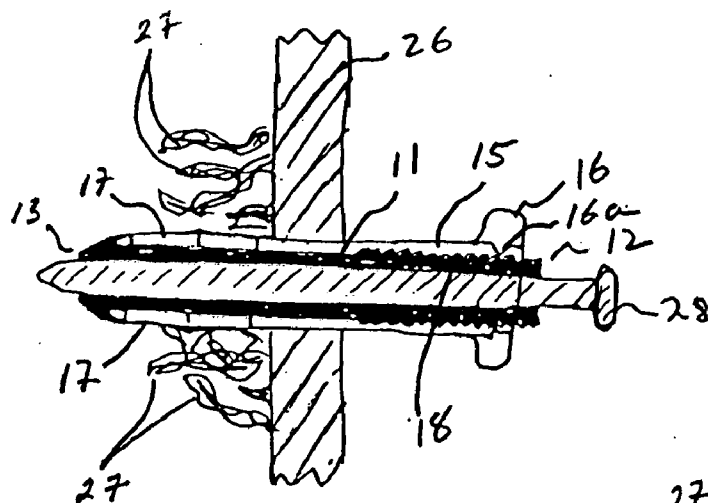


Fig 8

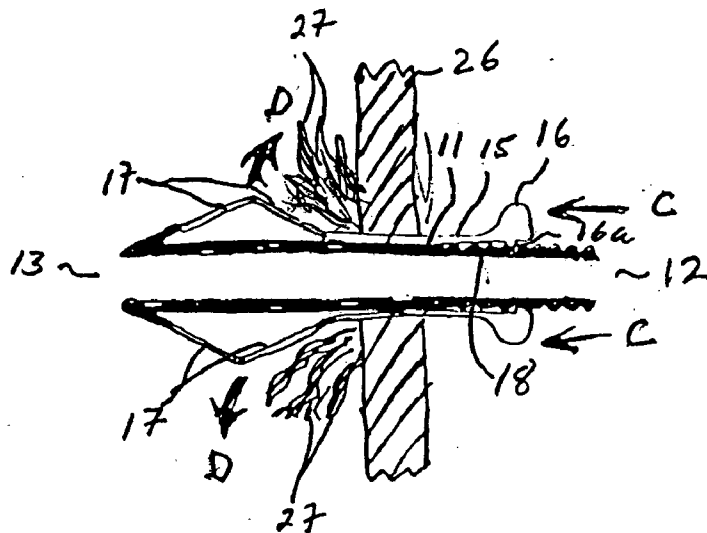
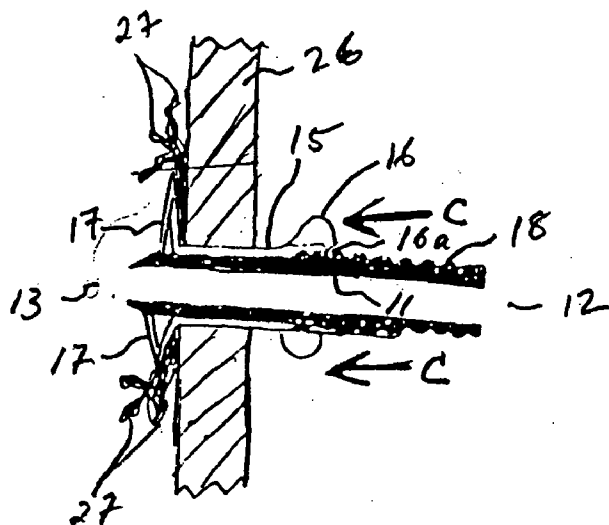


Fig 9



CLEAR VIEW CANNULA

FIELD OF THE INVENTION

[0001] This invention relates to a clear view cannula for use in surgical procedures. More particularly, this invention relates to a clear view cannula that permits an operator to insert the cannula through a body wall into an anatomical cavity, maintain the cannula in its inserted position, and introduce an auxiliary surgical instrument into the anatomical cavity through the cannula without visual or mechanical obstruction within the body wall.

BACKGROUND OF THE INVENTION

[0002] The use of surgical instruments such as cannulas to introduce an auxiliary surgical instrument into a body such as a joint, abdominal cavity, or the like is well known and widely used. A typical procedure can include making a small incision in the desired portion of the body wall, inserting a cannula into and through the incision and introducing an auxiliary surgical instrument through the cannula into the body to perform a further procedure.

[0003] In order to be thoroughly effective and minimize trauma to a patient, it is desirable in such procedures that the cannula be capable of being anchored or secured and not slip out of the anatomical cavity thereby preventing its reinsertion and that fragmented or torn soft tissue not have to be removed from the area surrounding the insertion point of the cannula in order to ensure that the auxiliary instrument can be used without visual or mechanical obstruction.

[0004] Several attempts have been proposed to overcome these problems and deficiencies. For example, U.S. Pat. No. 5,217,451 to Freitas discloses a trocar assembly having first and second cylindrical members secured to one another at the distal end of the assembly and a sleeve portion having a series of radially extending flexible members. This device has many small parts and is operable through the use of an interacting gear mechanism. Since the radially extending members, when fully deployed, form an acute angle substantially less than 90 degrees with respect to the longitudinal axis of the cylindrical members, they are not capable of effectively retaining or retracting torn or fragmented soft tissue within a body cavity; that is, the spaces between the fully deployed members permit torn or fragmented soft tissue to visually and mechanically obstruct the use of an instrument such as a camera that is typically introduced through a cannula prior to performing a surgical procedure.

[0005] U.S. Pat. No. 5,632,761 to Smith, et.al. discloses a device used to dissect and retract layers of tissue while a portion of the device is retained in a patient. The device utilizes two balloons, the first of which is inserted between layers of tissue and inflated to dissect the tissue layers after which the balloon is deflated. The second balloon is then positioned between the tissue layers and inflated to retract the tissue layers. The device includes a tube coaxially mounted to a delivery portion. The tube has a contracting portion and is provided with a number of deformable, longitudinally extending segments. This device also has many small moving parts and, due to the spherical shape of the second balloon, is not capable of fully retracting torn or fragmented soft tissue. Consequently, the device would have to be inserted deeper into a patient in order to be fully effective.

[0006] U.S. Pat. No. 5,637,097 to Yoon discloses an instrument used to penetrate an anatomical cavity having a fixed or retractable penetrating member, the distal end of which is used for penetration, and a portal sleeve having an expandable portion fixed relative to the penetrating member. This instrument, as with the devices described above, comprises many components and functions primarily to anchor the instrument within an anatomical cavity. The anchoring component is not designed to effectively retract or retain torn or fragmented soft tissue within the anatomical cavity.

[0007] These illustrative devices typically comprise many parts requiring costly and time consuming assembly. Since they are of relatively complex construction, subsequent cleaning and sterilization would also be costly and time consuming. In addition, these devices are not designed to effectively retract and retain torn or fragmented tissue within an anatomical cavity while, at the same time, anchoring the device within the cavity so that only a minimal portion of the device is retained in the cavity. Due to their complex structures, these devices are cumbersome to handle and manipulate by an operator. Furthermore, these illustrative devices are typically designed to function within a relatively large body cavity such as the abdomen where maneuverability is relatively unrestricted.

SUMMARY OF THE INVENTION

[0008] It has now been found that the shortcomings of such prior art devices are overcome by the clear view cannula of this invention. In general, the clear view cannula of the invention comprises: a tubular body having a proximate end and a distal end; a plurality of closely spaced teeth members formed on the outer surface and extending parallel to the longitudinal axis of said tubular body intermediate its proximate and distal ends; a cylindrical sleeve having a proximate end and a distal end concentrically mounted about and slidably secured to said tubular body; means at the proximate end of said cylindrical sleeve to engage said teeth members; and, a plurality of spaced apart shield members circumferentially disposed about and longitudinally co-extensive with said tubular body secured to the distal end of said cylindrical sleeve such that when said cylindrical sleeve is slidably urged along said tubular body toward the distal end of said tubular body, said shield members are caused to expand and deploy enabling said shield members to retract and retain torn or fragmented soft tissue within an anatomical cavity and anchor said clear view cannula within an anatomical cavity with a minimum of penetration of said clear view cannula into an anatomical cavity.

[0009] The means to secure the cylindrical sleeve to the teeth members as the cylindrical sleeve is slidably moved along the tubular body is readily provided by a detent depending from a raised shoulder at the proximate end of the cylindrical sleeve.

[0010] The shield members at the distal end of the cylindrical sleeve and are manufactured so as to be capable of being flexed intermediate their ends enabling them to be fully deployed and expanded within an anatomical cavity.

[0011] In one embodiment, the shield members are provided with an expandable web member so that when the shield members are fully deployed, the expandable web member fills the spaces between them thereby further assur-

ing that any torn or fragmented tissue is completely retracted and retained within the body of a cavity.

[0012] Although the clear view cannula of the invention can readily be used in large body cavities such as the abdomen, it is particularly useful in smaller cavities such as joints; i.e., knees, shoulders, elbows, ankles, and the like. During arthroscopic surgery of a joint, the joint is typically inflated with water as opposed to a gas which is typically used in abdominal surgical procedures as the surgical procedures performed within a joint are significantly different from those performed within an abdominal cavity.

[0013] For example, the inside of a joint such as the knee is lined with a layer of a friable tissue called the synovium which is about $\frac{1}{2}$ cm. thick. In patients about to undergo arthroscopic surgery, the synovial tissue is often inflamed and is also frequently torn and fragmented. In addition, there is present in the anterior portion of the knee joint a patella fat pad (or blob of fat tissue) which generally measures about 3×5 cm. square. Thus, inflamed and/or torn and fragmented synovial tissue and the patella fat pad in the knee joint serve to restrict and impede visualization of the joint cavity by the surgeon. However, this restricted vision is completely overcome when using the clear view cannula of the invention.

BRIEF DESCRIPTION OF THE DRAWING

[0014] The clear view cannula of the invention will become more apparent from the ensuing description when considered together with the accompanying drawing wherein:

[0015] FIG. 1 is a plan view of one embodiment of the clear view cannula of the invention, part shown in phantom to illustrate further details thereof;

[0016] FIG. 2 is an elevation sectional view of the clear view cannula shown in FIG. 1 taken substantially on the line 2-2 of FIG. 1;

[0017] FIG. 3 is a view looking substantially in the direction of arrow A of FIG. 2;

[0018] FIG. 4 is a view looking substantially in the direction of arrow B of FIG. 2;

[0019] FIG. 5 is a schematic, partly fragmented side elevational view of a prior art cannula showing deployment of flexible members at its distal end;

[0020] FIG. 6 is a schematic, partly fragmented side elevational view of the cannula of the invention showing deployment of the shield members at its distal end;

[0021] FIG. 7 is a schematic side sectional view illustrating insertion of the clear view cannula of FIG. 1 through a body wall and into an anatomical cavity;

[0022] FIG. 8 is a schematic, partly fragmented side sectional view illustrating partial expansion and deployment of the shield members of the clear view cannula shown in FIG. 7; and,

[0023] FIG. 9 is a schematic, partly fragmented side sectional view illustrating the shield members shown in FIG. 8 in a fully expanded and deployed position within an anatomical cavity.

DETAILED DESCRIPTION OF THE DRAWING AND THE INVENTION

[0024] Turning now to the drawing wherein like reference numerals and letters identify like parts, there is shown in FIGS. 1 and 2 one embodiment of the clear view cannula of the invention generally identified by reference numeral 10 which typically comprises a tubular cannula body 11 having a proximate end 12 and a distal end 13 which is normally tapered as indicated at 14 to facilitate entry or penetration of the cannula 10 through a body wall and into an anatomical cavity.

[0025] A cylindrical sleeve 15 is concentrically mounted about and slidably secured to the cannula body 11 in a close fitting relationship. The cylindrical sleeve 15 extends from adjacent the proximate end 12 of cannula body 11 toward the distal end 13 of cannula body 11 a distance of from about $\frac{1}{2}$ to about $\frac{3}{4}$ the length of the cannula body 11. Cylindrical sleeve 15 is provided with a raised shoulder 16 at its proximate end and a plurality of spaced apart shield members 17 secured to its distal end. The shield members 17, shown partially deployed in FIGS. 1 and 2, are circumferentially disposed about and longitudinally co-extensive with the cannula body 11. Cylindrical sleeve 15 can be secured to the cannula body 11 by any suitable and conventional means such as apertures formed in the cannula body 11 which mate with nipples on the inner surface of the cylindrical sleeve 15 in a snapfit relationship (not shown). Other means such as spot welding, fusion, and the like, can also be readily used as will be apparent to those skilled in this art.

[0026] As can be best seen in FIG. 2, a plurality of closely spaced apart teeth members 18 are provided on the outer, circumferential wall of the cannula body 11 and extend from the proximate end 12 toward the distal end 13 a distance of from about $\frac{1}{2}$ to about $\frac{3}{4}$ of the length of the cannula body 11; that is, teeth members 18 are provided along the cannula body 11 for a distance about equal to the length of cylindrical sleeve 15. Teeth members 18 are formed to have a substantially perpendicular face 19 and a rear portion 20 that slopes toward proximate end 12. Preferably, the sloping rear portion 20 of each tooth member 18 terminates at the base of the perpendicular face 19 of each preceding tooth member 18. The inner end of shoulder 16 is formed to terminate in a depending detent 16a which engages the faces 19 of the teeth members 18 as described more fully hereinbelow.

[0027] The proximate end 12 of cannula body 11 is provided with a handle 21 which can be in any geometrical form that will enable a user to readily grasp the handle 21 with the fingers one hand and concurrently manipulate the cylindrical sleeve 15 toward and away from the distal end 13 of the cannula body 11 with another finger of the same hand. For example, the geometric form of handle 21 can be oblong, spherical, round, square or rectangular as such forms will readily enable a user to comfortably and easily grasp the handle 21 and manipulate the cylindrical sleeve 15 with the fingers of one hand while retaining complete control of the cannula 10.

[0028] A pair valve members 22 and 22a (FIG. 2) are secured within handle 21 to prevent liquid within a joint or body cavity from leaking out of the proximate end 12 of the cannula 10 after the cannula 10 has been inserted into a body cavity. Valve members 22 and 22a can be provided from any suitable flexible material such as rubber or latex that will

prevent seepage or leakage of fluid from a body cavity through the proximate end **12** of the cannula **10**. A cross-shaped or X-shaped slit **23** is formed in each of the valve members **22** and **22a** to enable an instrument to be inserted through the valve members **22** and **22a** and through the cannula body **11**.

[0029] To further prevent leakage or seepage of fluid from a body cavity, a gasket such as a rubber or latex O-ring **24** is seated between the outer circumferential surface of cannula body **11** and the inner circumferential surface of cylindrical sleeve **15** intermediate the proximate end **12** and the distal end **13** of cannula **10** as shown in **FIG. 2**.

[0030] As illustrated in **FIGS. 1 and 2**, shield members **17** are formed to have a cross-sectional thickness at their approximate mid-points indicated by **17a** that is thinner than the cross-sectional thickness at their extremities indicated by **17b**. This enables shield members **17** to be readily flexed from substantially flat, at rest condition to a fully deployed condition after the cannula **10** has been inserted into a body cavity.

[0031] **FIG. 4** illustrates the configuration of the shield members **17** when fully deployed within a body cavity. In order to fill the spaces between the shield members **17**, an expandable web member **25** can be secured to the shield members **17** to further assure that any torn or fragmented tissue is completely retracted and retained within a body cavity when the shield members **17** are fully deployed.

[0032] **FIGS. 7, 8 and 9** of the drawing illustrate typical, sequential steps that can be employed in using the clear view cannula of the invention. As can be seen in **FIG. 7**, the cannula body **11**, is shown being inserted through a body wall **26** and into an anatomical cavity such as a knee joint. Although insertion is typically made through a pre-formed incision, such insertion and penetration generally results in torn and fragmented soft tissue **27** which can obstruct or otherwise interfere with the use of an auxiliary surgical instrument. Such obstruction or interference is virtually eliminated by using the clear view cannula of the invention.

[0033] **FIG. 7** also shows the insertion of a trocar **28** through cannula body **11** which is typically initially introduced into a body cavity and then subsequently removed and replaced with a surgical instrument such as a camera.

[0034] After the cannula body **11** has been inserted through the body wall **26** as shown in **FIG. 7**, an operator, using only finger tip pressure against shoulder **16**, simply urges cylindrical sleeve **15** to slide along the cannula body **11** in the direction of arrows C as illustrated in **FIG. 8**. This causes shield members **17** to expand and deploy in the direction of arrows D toward the fragmented and torn tissue **27**. As an operator continues to expand and deploy the shield members **17** in this manner, the operator can also withdraw the cannula body **11** outwardly through the body wall **26**. Accidentally fully withdrawing the cannula body **11** through the body wall **26** is prevented by the partially expanded and deployed shield members **17** contacting and engaging the inner surface of the body wall **26**.

[0035] As the operator withdraws the cannula body **11** outwardly, the shield members **17** are maintained in their partially expanded and deployed condition by annular detent **16a** firmly and securely engaging the perpendicular face **19** of a tooth member **18**.

[0036] Urging of the cylindrical sleeve **15** to slide along the cannula body **11** is facilitated by the sloping rear portions **20** of the teeth members **18**.

[0037] Typically, an operator will continue to slidably urge the cylindrical sleeve **15** along the annular body **11** and withdraw the cannula body **11** through the body wall **26** in this manner until the shield members **17** are fully expanded and deployed retaining the torn and fragmented tissue **27** against the inner surface of the body wall **26** with only a small portion of the distal end **13** of the cannula body **11** retained and locked in place within the body wall **26** as illustrated in **FIG. 9**. At this time, the shield members **17** are locked in their fully expanded and deployed condition and the cannula body **11** is firmly secured within the body wall **26** by means of the detent **16a** engaging the perpendicular face **19** of a tooth member **18**.

[0038] In **FIG. 5** there is illustrated a typical prior art cannula such as that disclosed in U.S. Pat. No. 5,217,451 to Freitas discussed above. As can be seen in **FIG. 5**, when the flexible members **30** of this prior art cannula are fully deployed, they form an acute angle of substantially less than 90 degrees with respect to the longitudinal axis of a cannula body **31**. Consequently, torn and fragmented tissue can not be effectively retained within an anatomical cavity which would, in turn, interfere with an operator's view within the cavity.

[0039] Since the flexible members **30** (**FIG. 5**) when fully deployed form an acute angle, they encompass a distance "y" along the cannula body **31**. This prevents the cannula body **31** from being withdrawn from within a body cavity which, in turn, creates a further distance "x" from the distal end **32** of the cannula body **31**. Consequently, the distal end **32** of this cannula body **31** will extend into a body cavity the distance indicated by "z"; i.e., the sum of distances "y" and "x".

[0040] By contrast, the structure and operation of the clear view cannula of the invention permits its shield members **17** to be deployed at an angle that is substantially coincidental to 90 degrees with respect to the longitudinal axis of the cannula body as is illustrated in **FIG. 6**. This results in substantially reducing both the "x" and "y" distances enabling the cannula body **11** to be withdrawn through the wall of a body cavity until its withdrawal is arrested by the deployed shield members **17** and optionally, the expandable web member **25**, leaving only a relatively small portion of its distal end **13** extending into a body cavity as is shown in **FIG. 6**. Thus, the total distance "z" that the cannula body **11** of the present invention extends into a body cavity is significantly and substantially less than the prior art cannula illustrated in **FIG. 5**. This significant and substantial reduction of extension into a body cavity is highly advantageous, particularly when surgical procedures are to be performed within the very limited confines of a body joint.

[0041] The materials used to fabricate the clear view cannula of the invention are not critical provided they are suitable for use in surgical procedures. For ease of fabrication, assembly and use, all components of the clear view cannula of the invention; i.e., the cannula body **11** carrying teeth members **18**, cylindrical sleeve **15** with annular collar **16** and detent **16a**, and shield members **17** are preferably fabricated from well known and commercially available plastic materials that are suitable for use in surgical procedures.

[0042] Although the clear view cannula of the invention has been described in detail and with particularity, it will be appreciated by those skilled in this art that changes and modifications can be made therein without departing from the scope and spirit of the invention.

1-13. (Canceled)

14. A method using a clear view cannula in anthroposcopic surgery comprising the steps of:

- a. Providing a clear view cannula suitable for providing visibility within a joint cavity of a patient, the clear view cannula having a tubular body and a cylindrical sleeve defining a longitudinal axis, the clear view cannula defining a through hole aligned with the longitudinal axis and having shield members configured for expanding substantially perpendicular to the longitudinal axis of the cannula while creating only a minimal penetration into a body of a patient, the clear view cannula including a single piece handle and a shoulder being adapted for use by one hand of a surgeon, the complete control of the clear view cannula being done by the one hand of the surgeon, the tubular body including and the shoulder being configured to engage the teeth and lock the cylindrical sleeve in position relative to the tubular body;
- b. making an arthroscopic penetration of a body wall of a patient using a distal end of the clear view cannula in a first position and positioning the shield members inside a body wall of the patient;
- c. moving the cylindrical sleeve distally relative to the tubular body using finger pressure of the one hand of the surgeon to expand the shield members from the first position aligned with the longitudinal axis of the clear view cannula to the second position wherein the shield members are approximately perpendicular to the longitudinal axis of the clear view cannula, positioning the proximal side of the shield members against the inside of the body wall, the clear view cannula being configured to minimized the distance of penetration of the distal end of the cannula into the patient in the second

position, the shield members being configured for securing the torn or fragmented tissue associated with the arthroscopic penetration against the inner surface of the body wall, using the clear view cannula to visualize a joint cavity of the patient; and

- d. returning the clear view cannula to the first position by repositioning the shoulder of the cylindrical sleeve proximally relative to the tubular body so as to return the shield members to the first position using only the one hand of the surgeon, withdrawing the clear view cannula from the body of the patient.

15. The method of claim 14, wherein the step of making a penetration includes using the clear view cannula for the initial penetrating of the body on a joint of a patient.

16. The method of claim 14, wherein the step of making a penetration includes inserting the clear view cannula in an incision.

17. The method of claim 15, wherein the step of making a penetration includes using a trocar positioned in the through hole of the clear view cannula to penetrate the tissue of a patient.

18. The method of claim 14, wherein the step of moving further includes the surgeon applying a proximally directed pull on the handle relative to the cylindrical sleeve to move the shield members from the first position to the second position.

19. The method of claim 14, wherein the step of moving further includes a surgeon applying finger pressure on the shoulder relative to the tubular body to move the shield members from the first position to the second position.

20. The method of claim 14, wherein the step of moving further includes positioning a camera through the clear view cannula, the camera being adapted to visualize a joint cavity of the patient, the shield members in the second position being configured to improve the internal visibility of the camera through the arthroscopic portal by retracting and retaining the torn or fragmented tissue associated with the arthroscopic portal against the inner surface of the body wall.

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