



- (51) **International Patent Classification:**
A61B 17/34 (2006.01) **A61B 17/00** (2006.01)
- (21) **International Application Number:**
PCT/AU2012/001502
- (22) **International Filing Date:**
7 December 2012 (07.12.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
201 1905092 7 December 2011 (07.12.2011) AU
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- (81) **Designated States** (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU,
RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ,
TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA,
ZM, ZW.

- (84) **Designated States** (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** SURGICAL TROCAR

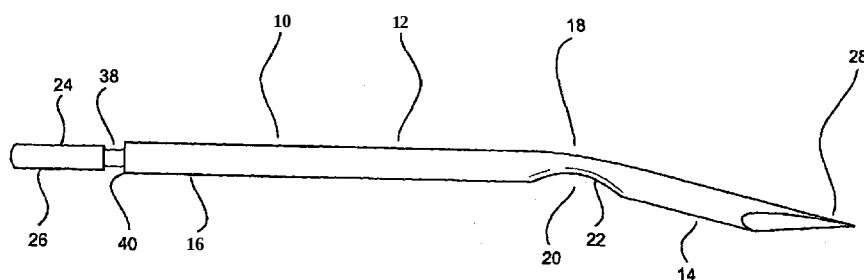


Fig. 2

(57) **Abstract:** A surgical trocar (10) has an elongate shaft (12) with a leading point or edge (28) for piercing flesh and a thumb grip region (22) at an inner bend region (18). The grip region may include a flat zone and can be integral with the shaft, optionally stamped or pressed into the material of the shaft.

SURGICAL TROCAR

FIELD OF THE INVENTION

[0001] The present invention relates to a surgical trocar, such as used to introduce a wound drainage tube into a patient to effect closed wound drainage after surgery.

BACKGROUND TO THE INVENTION

[0002] Many patients require closed wound drainage after surgery. Closed wound drainage relies on a drainage tube sewn into a wound. The drainage tube extends out of the wound and connects to a source of vacuum, such as a vacuum container with vacuum level control valve. Fluids gathering in the wound after surgery are moved through the drainage tube and collected in the container. A surgical trocar is a stainless steel implement used to introduce the drainage tube into the wound. The surgical trocar typically is a smooth stainless steel shaft with a point at a leading end to pierce skin, and a ridged connector at a trailing end for attachment to the drainage tube. In use, a rear or trailing end of the surgical trocar is attached to a leading end of the drainage tubing. A surgeon then manually uses the surgical trocar to pierce a hole through the skin (and any fat and muscle) of the patient from the internal surface to the outer (epidermal) skin surface. The surgical trocar is then removed from the drainage tubing, often by cutting through the drainage tubing adjacent the surgical trocar.

[0003] Because of the natural presence of blood and during surgery, particularly on the gloved hands of the surgeon, the smooth stainless steel shaft of the surgical trocar often becomes slippery and difficult to grip. The slippery surgical trocar rotates in or slips through the surgeon's grip when trying to pierce through the patient's skin and when trying to pull the trocar through from the external side of the skin after initial piercing. This slippage risks injury to the

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surgeon and delay to the surgical procedure and possible damage to the patient. Attempts have been made to resolve this slippage problem.

[0004] Published US patent 4,490,136 proposes a flattened oblong section straight or angled shaft surgical trocar, the flattened oblong shape aims to reduce the risk of slipping in the surgeon's hands, and the oblong hole produced by the angled sharpened leading end aims to produce a fissure shaped incision. The drainage tube is connected to a barbed spigot at the rear end of the trocar protected by an enlargement that narrows at its leading end and flares out to an enlarged end where the drainage tube connects to the trocar. However, the shaft of this trocar is smooth and does not provide any grip feature on its surface to reduce the likelihood of slipping. Also, the barbed spigot causes the leading end of the drainage tube to flare out to get over the widest part of the barb. Hence, US 4,490,136 proposes the enlarged portion to compensate for this forced widening and attempts to smoothly and progressively increase the effective width of the trocar, thereby attempting to avoid a step in width, by providing the gradually widening enlargement portion.

[0005] Another attempt to reduce the slippage problem has been to provide a series of shallow grip notches across a portion of the width of the straight shaft of the trocar. However, such notches only have limited grip benefit to prevent the trocar from rotating in the surgeon's hand when piercing the skin, and limited grip benefit when trying to push the trocar through the skin.

[0006] One known attempt to improve grip on a trocar to introduce a catheter or other tube into a subcutaneous tunnel is disclosed in GB 2103936A. That document discloses a rod or tube having a hand grip at a proximal end and, at a distal end, a detachable tip for passing smoothly through subcutaneous tissue to introduce the catheter or other tube through the tissue wall. Thus, effectively this document discloses a trocar with detachable handle at the end opposite to the detachable working tip or point of the tool. The hand grip is relatively bulky and does not allow for pre-connection of the catheter prior to making an incision into a

patient with the tool. This therefore complicates the catheter introduction procedure and requires a separate step of removing the hand grip and attaching the catheter to the proximal end of the rod or tube.

[0007] An alternative attempt at providing improved user grip on a trocar is disclosed in US 4,883,474A. That document provides a tube having a stiffened and sharpened end. The stiffened end is a rigid rod extending inside the tube and the rod is shapeable into a grippable shape to assist the user in maneuvering the rod and tube into and through the desired path in the surgical site. Thus, US 4,883,474 teaches the shaping of a rigid rod within tubing to assist in providing grip.

[0008] With the above problems in mind, it has been found desirable to provide an improved surgical trocar that improves grip when pushing the trocar through the skin and reduces the likelihood of the trocar rotating in the surgeon's hand at that time.

[0009] Reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of admission that the prior art forms part of the common general knowledge in Australia.

SUMMARY OF THE INVENTION

[0010] With the aforementioned in view, an aspect of the present invention provides a surgical trocar including an elongate shaft having a first and second shaft portions, the second shaft portion including a leading point or edge for piercing flesh, the shaft further including a curved portion intermediate the first and second shaft portions, the curved portion having an inner and an outer radius, the shaft further including a grip region.

[001 1] The grip region may include at least one flat zone, preferably integral with the shaft. The integral grip may be provided by at least one flat recess in the shaft.

[001 2] The grip region may include a machined, stamped or pressed region in the material of the shaft.

[0013] At least a portion of the grip region may be located at the inner radius of the curved portion.

[0014] The grip region may be or include a thumb grip for a user when pushing the surgical trocar through the skin.

[001 5] Preferably the shaft has a width and the grip region includes at least one zone that is wider than the width of the shaft. This feature is particularly useful where the shaft is narrow in width, such as under 4.5mm wide. The grip region can broaden out the width of the shaft, such as an elliptical or oval shaped flared region. Alternatively the grip region is preferably no greater in width than the width of the shaft.

[0016] The first shaft portion between the connector and the curved portion may preferably be longer than the second shaft portion between the curved portion and the leading point or edge.

[001 7] Preferably the second shaft portion is between 30mm and 80mm long from the curved portion to a tip of the leading point or edge.

[001 8] An alternative form of the present invention provides a surgical trocar including an elongate shaft having a first and second shaft portions, the second shaft portion including a leading point or edge for piercing flesh, the first and second shaft portions connected by a curved portion, the curved portion having an inner and an outer radius, the first shaft portion including a connector for

receiving a portion of tubing to be introduced into a patient by the trocar, the connector having a continuous surface for contacting a lumen of the tubing.

[0019] The connector may be joined to the rest of the first shaft portion by a neck portion with a width less than that of the connector and rest of the first shaft portion. Preferably the connector may have a regular cylindrical outer surface to contact the lumen of the tubing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] **Figures 1 and 2** show respective plan and side views of a trocar according to an embodiment of the present invention.

[0021] **Figures 3 and 4** show respective plan and side views of a trocar according to an alternative embodiment of the present invention.

[0022] **Figures 5 and 6** show plan and side views of an alternative embodiment of the present invention.

[0023] **Figures 7 and 8** show the trocar of figures 2 and 6 respectively held in a hand of a user with the user's thumb in a grip region.

[0024] The invention will now be described with reference to the accompanying figures.

[0025] The surgical trocar **10** according to an embodiment of the present invention shown in figures 1 and 2 is of a type to be used for introducing a drainage tube into a wound for closed wound drainage. Once introduced into the wound channel by pushing the trocar through the tissue wall (skin and subcutaneous fat), the proximal end of the tubing is detached from the trocar,

often by simply cutting through the tubing, and is sewn into the wound. The distal end of the tubing terminates at a container holding a partial vacuum controlled by a valve. Fluids are drained from the closed wound through the tubing and into the container under the influence of vacuum.

[0026] The surgical trocar has a shaft 12 with a first shaft portion 14 and a second shaft portion 16 joined at a curved portion 18. It will be appreciated that the first or second portion of the shaft, or both, may themselves be straight or curved. Preferably, and as shown in figures 1 and 2, the first and second shaft portions are straight, and are connected by a curved intermediate portion. The inner radius 20 of the curved portion includes a flat zone 22 providing a thumb grip region. In use, a user would grip with one hand the first portion of the shaft between the curved portion and the connector 26 at the rear end 24 of the surgical trocar. The user's thumb can then rest on the flat zone 22 in use. When in use, pushing the point 28 through a patient's skin from the body's internal skin surface to the external skin surface, the point usually causes the skin to 'tent' up before piercing through. Substantial effort is required by the user to drive the trocar through the layers of skin (and any fat or other tissues) in order to introduce an attached drainage tube into a wound and allow the drainage tube to exit through the aperture in the skin created by the trocar. If, as is often the case, the user's hands or gloves are wet with blood or other fluids, the trocar can rotate in the user's grip or the user's hand can slide along the shaft of the trocar because sufficient grip friction is not available. The flat area at the inner radius of the curved portion not only gives a larger surface to apply pressure to compared with the curvature of the shaft, but also, because the flat surface is in the inner radius, allows the user to apply forward force and gain additional grip by thumb contact with the leading end of the flat area within the inner radius. Thus, the user not only gains better purchase on the shaft but is also able to apply greater forward force to pierce the skin and have enhanced anti-rotation grip on the trocar.

[0027] An alternative embodiment of the present invention is shown in Figures 3 and 4. This embodiment has the same features as those of figures 1 and 2;

however, the trocar is a different gauge, 19 French, than that of the 16 French gauge of the trocar in figures 1 and 2. Essentially, the shaft 12 is thicker overall.

[0028] An alternative embodiment of the surgical trocar of the present invention includes a grip region 30 wider than the width of the shaft 12 of the trocar. As shown in figures 5 and 6, the shaft is narrower than that of the trocar of figures 1 to 4. The grip region is flared out 32, for example in the form of a 'cobra head', being wider in a middle section of the flat region than the ends thereof which merge into the shaft. This allows a narrow shaft trocar, such as a 10 French gauge trocar, to include features of the present invention without overly thinning the shaft and otherwise making the shaft too weak or bendy. The grip region 30 is formed at the inner radius 20 as provided on the trocars shown in figures 1 to 4. The outer radius 34 may retain the original boundary of the first and second shaft portions, or may be inset or recessed 36, as shown in figures 5 and 6.

[0029] Any of the embodiments of the present invention may include a textured surface on the grip region 22,30 for enhanced friction. This may be formed by texturing the metal surface of the trocar or applying a grip material, such as a silicon rubber coating.

[0030] As shown in figures 1 to 6, the connector 24 preferably includes a relatively smooth, flat surfaced cylindrical shape to increase contact area with the lumen of the drainage tubing (not shown). The smooth surface increases contact area with the lumen compared to a barbed connector. This improves grip with the tubing, especially with silicon polymer type tubing, and advantageously prevents the tubing from bulging out when fitted over the barb(s) of a connector. Preferably the first shaft portion and the connector have common thinned annular region, such as a groove 38, and the connector is narrower than the width of the first shaft portion, which allows the leading end of the drainage tubing to butt up against a rear end face 40 of the first shaft portion and thereby prevents a bulge.

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This beneficially reduces the rear end width of the trocar when being pushed/pulled through the piercing in the patient.

[0031] In a 19 French gauge trocar embodying the present invention, the connector may be 4.85mm diameter, the annular recess 3.60mm diameter and the main shaft 6.35mm diameter. A 16 gauge trocar embodying the present invention may have a 4.20mm diameter connector, a 2.75mm diameter annular recess and a 5.40mm main shaft. Preferably the first portion of the shaft is within the range 35mm to 80mm, though other lengths are considered within the scope of the present invention. The grip region may preferably be at least 15mm long, preferably between 16mm and 25mm.

[0032] Advantageously, the grip region gives enhanced anti-rotation control over the trocar, particularly when it is slippery, compared to other round section trocars, and also improves grip when pushing the trocar forward through tissue.

[0033] Figures 7 and 8 show the trocar of figures 2 and 6 respectively held in a hand 40 of a user with the user's thumb 42 in a grip region 22,30. The user's thumb 42 sits in the recess of the grip region provided at the inner radius of the curve or elbow of the trocar shaft. This thumb grip provides extra control over rotation of the trocar in the user's hand and better grip pushing forward through body tissue. For rotation control, the flatter region in the recess provides increased surface area contact between the user's thumb and the shaft when compared with a standard round section shaft trocar, but maintains the benefit of a circular shaft for finger grip and circular or near circular incision. The drainage tube 44 for the closed wound drain is shown attached to the connector 26. given that the connector is of thinner diameter than the shaft portion 16, the end of the tubing butts against the end of the shaft portion adjacent the annular recess described above.

CLAIMS:

1. A surgical trocar including an elongate shaft having a first and second shaft portions, the second shaft portion including a leading point or edge for piercing flesh, and the shaft further including a curved portion intermediate the first and second shaft portions, the curved portion having an inner and an outer radius, the shaft further including a grip region.
2. A surgical trocar as claimed in claim 1, wherein the grip region includes at least one fiat zone.
3. A surgical trocar as claimed in claim 1 or 2, wherein the grip region is integral with the shaft.
4. A surgical trocar as claimed in any one of the preceding claims, wherein the grip region includes a recess in the shaft.
5. A surgical trocar as claimed in any one of the preceding claims, wherein the grip region includes a machined, stamped or pressed region in the material of the shaft.
6. A surgical trocar as claimed in any one of the preceding claims, at least a portion of the grip region is located at the inner radius of the curved portion.
7. A surgical trocar as claimed in claim 1 or 2, wherein the grip region is provided as a thumb grip for a user.
8. A surgical trocar as claimed in any one of the preceding claims, wherein shaft includes a width and the grip region includes at least one zone that is wider than the width of the shaft.

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9. A surgical trocar as claimed in any one of claims 1 to 7, wherein the grip region is no greater than the width of the shaft.
10. A surgical trocar as claimed in any one of the preceding claims, wherein the first shaft portion is longer than the second shaft portion.
11. A surgical trocar as claimed in claim 10, wherein the second shaft portion is between 30mm and 80mm long from the curved portion to a tip of the point or edge.
12. A surgical trocar including an elongate shaft having a first and second shaft portions, the second shaft portion including a leading point or edge for piercing flesh, the first and second shaft portions connected by a curved portion having an inner and an outer radius, the first shaft portion including a connector for receiving a portion of tubing to be introduced into a patient by the trocar, the connector having a continuous surface for contacting a lumen of the tubing.
13. A surgical trocar as claimed in claim 12, wherein the connector is joined to the rest of the first shaft portion by a neck portion with a width less than that of the connector and rest of the first shaft portion.
14. A surgical trocar as claimed in claim 12 or 13, wherein the connector has a regular cylindrical outer surface portion to contact the lumen of the tubing.

1 / 5

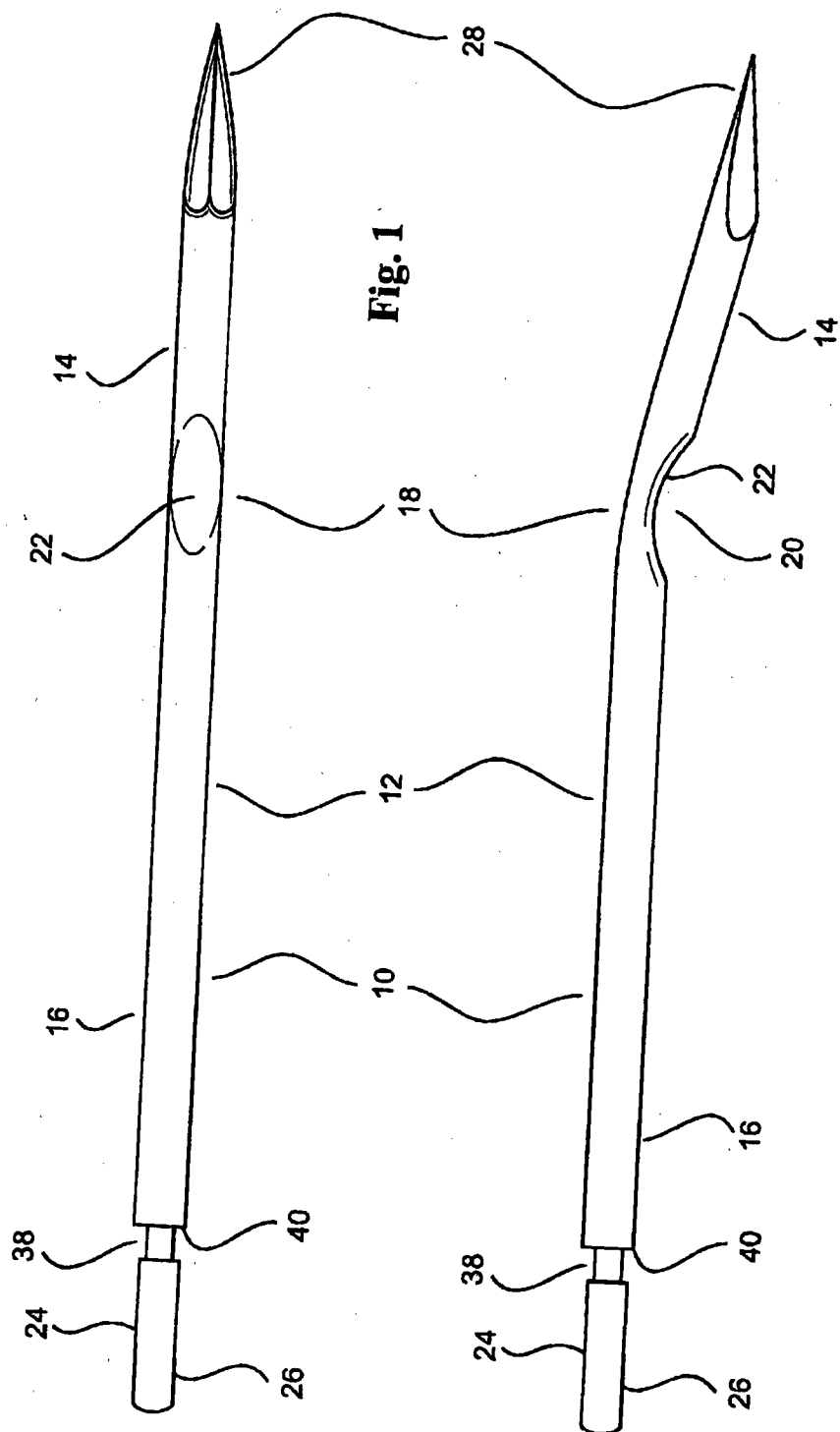


Fig. 1

Fig. 2

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Fig. 3

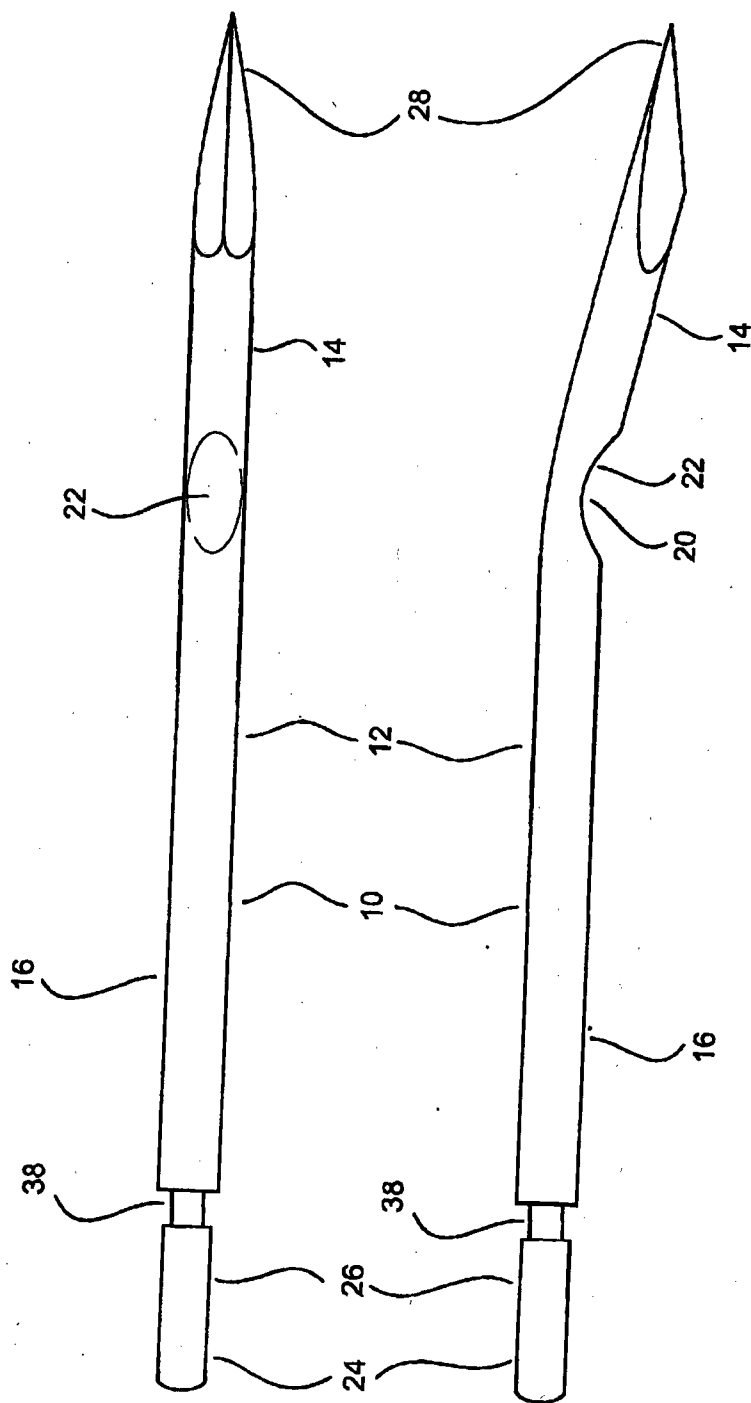


Fig. 4

3 / 5

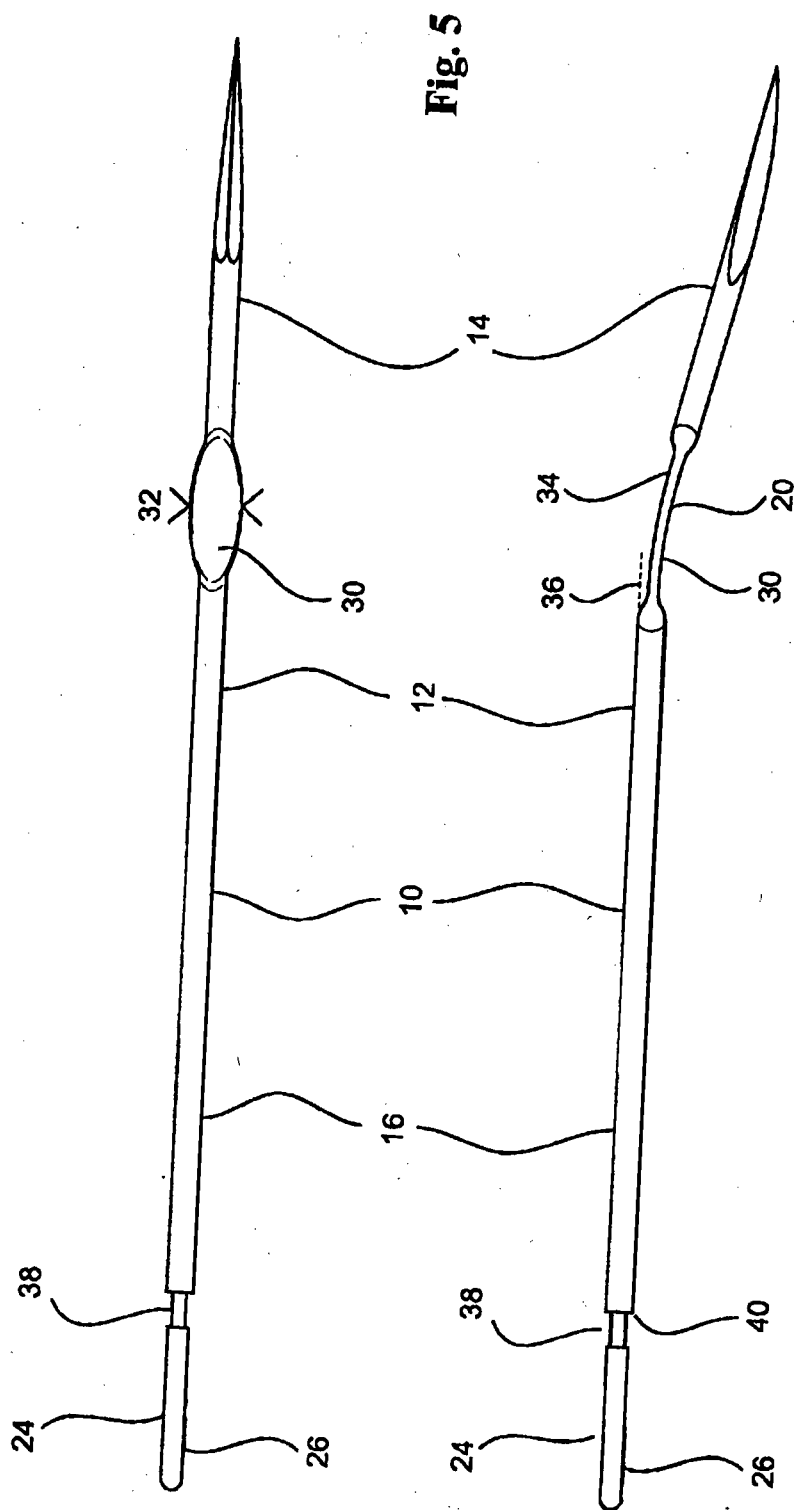


Fig. 5

Fig. 6

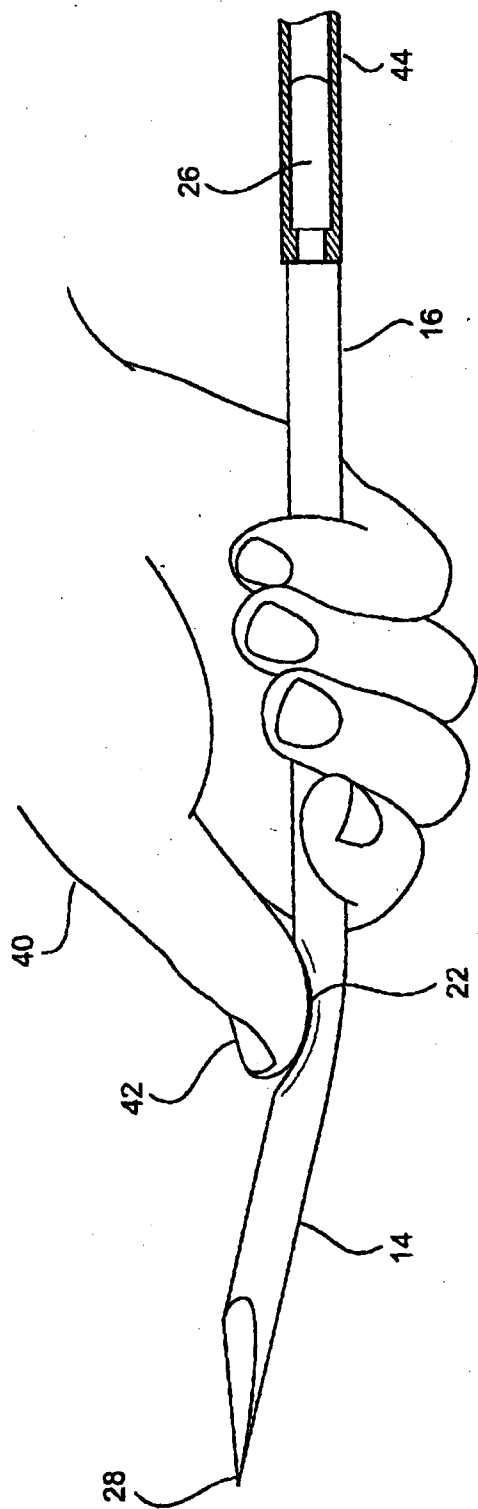


Fig. 7

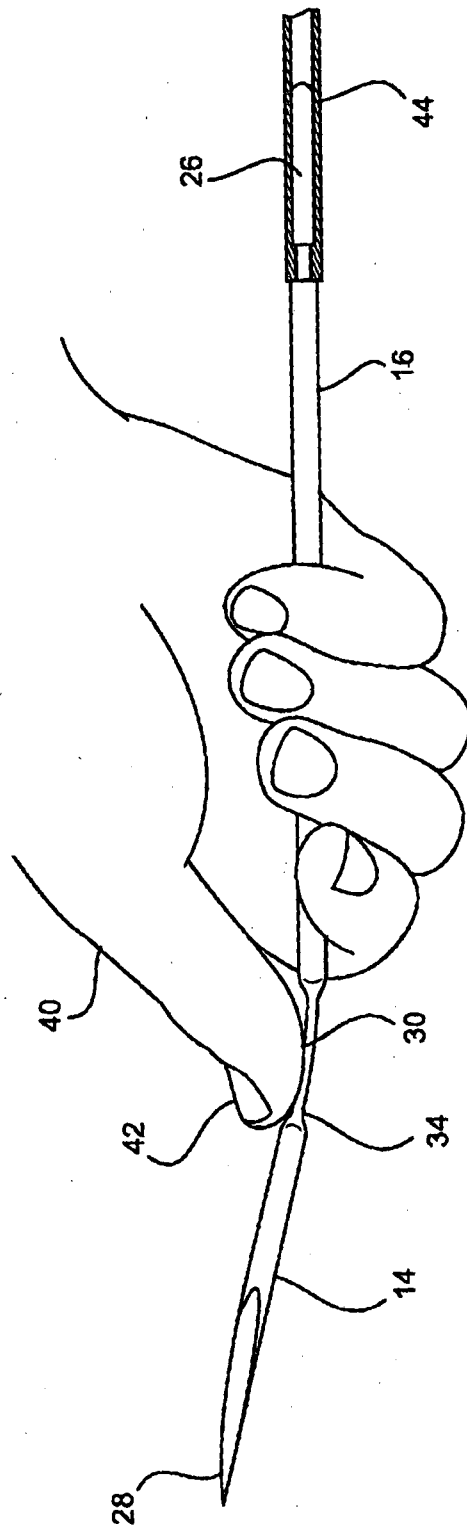


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/001502

A. CLASSIFICATION OF SUBJECT MATTER

A61B 17/34 (2006.01) A61B 17/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC: A61B 17/--, A61B 17/34 & Keywords (Trocar, Curve, Flat, Grip) and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

31 January 2013

Date of mailing of the international search report

31 January 2013

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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2012/001502
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/016184 A1 (RIZZO) 26 February 2004 Figure 1, Page 5 Line 5 - Page 6 Line 6	1-1 1
Y	Figure 1, Page 5 Line 5 - Page 6 Line 6	12-14
X	WO 2009/137761 A2 (VALIN) 12 November 2009 Figure 1-2, Page 3 Line 8 - Page 4 Line 9, Page 9 Line 8 - Page 11 Line 24	1-1 1
Y	Figure 1-2, Page 3 Line 8 - Page 4 Line 9, Page 9 Line 8 - Page 11 Line 24	12-14
X	US 4490136 A (EKBLADH et al) 25 December 1984 Figure 1-4, Column 2 Lines 9-55	12-14
Y	US 2010/0280368 A1 (CAN et al) 04 November 2010 Figure 3, Paragraph 21	12-14
A	EP 0769278 A2 (UNITED STATES SURGICAL CORPORATION) 23 April 1997 Abstract, Figures 1-13	1-14

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/001502

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Supplemental Box

Continuation of: Box III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-11 are directed to a surgical trocar. The feature of a grip region is specific to this group of claims.
- Claims 12-14 are directed to a surgical trocar. The feature of a connector for receiving a portion of tubing to be introduced into a patient by the trocar, the connector having a continuous surface for contacting a lumen of the tubing is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is **a surgical trocar including an elongate shaft having a first and second shaft portions, the second shaft portion including a leading point or edge for piercing flesh, the first and second shaft portions connected by a curved portion having an inner and an outer radius**

However this feature does not make a contribution over the prior art because it is disclosed in:

D1 (WO2004/016184) and D2 (WO2009/137761)

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a posteriori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2012/001502

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
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		EP 1850768 A1	07 Nov 2007
		EP 1850768 B1	18 Apr 2012
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		EP 0769278 A2	23 Apr 1997
		EP 0769278 B1	02 Jan 2004
		EP 1402827 A1	31 Mar 2004
		EP 1402827 B1	21 Jan 2009

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

Form PCT/ISA/210 (Family Annex)(July 2009)

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2012/001S02	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		JP 9187463 A	22 Jul 1997
		JP 4397974 B2	13 Jan 2010
		JP 2008086821 A	17 Apr 2008
		JP 4633783 B2	23 Feb 2011
		US 5807338 A	15 Sep 1998
		US 5980493 A	09 Nov 1999
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			