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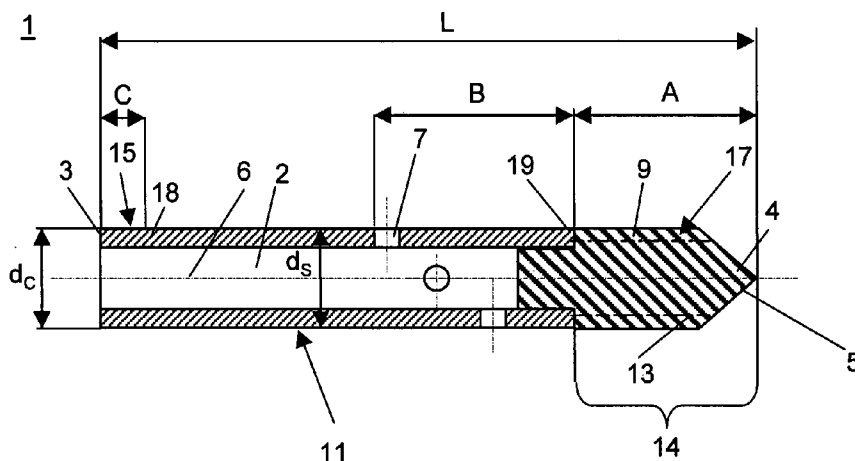


Fig. 1

(57) Abstract: A cannula (1) with a proximal end (3) and a distal end (4) comprising a shaft (11) with a lumen (2), a tip portion (14) including a cutting edge (12) and a coupling portion (15) terminally arranged at said proximal end (3) suitable for being connected to a surgical tool or instrument. Said shaft (11) further comprises at least one radial perforation (7). Said shaft (11) has a constant diameter d_s and said coupling portion (15) has a maximum diameter d_c which is equal or smaller than said diameter d_s of said shaft (11). A kit for irrigating bone tissue and subsequent injection of bone cement using said cannula and comprising an outer tube (20) with a through hole (21) for injection of bone cement, wherein said cannula (1) is rotatably and axially displaceably arranged in said through hole (21).

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Cannula and kit for injection of bone cement

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a cannula according to the preamble of claim 1, to a kit for irrigating bone tissue and subsequent injection of bone cement according to the preamble of claim 13 or 17, to a method for augmenting an implant for an improved fracture fixation according to the preamble of claim 21 as well as to a method for irrigation of bone tissue and subsequent injection of a bone cement according to the preamble of claim 24.

The augmentation of implants for improved fracture fixation in osteoporotic bone has a high potential to significantly enhance the implant anchorage. For instance, screws or blades used at the proximal femur may be augmented with bone cement in highly osteoporotic cases. The augmentation is often performed through the cannulation of the implant after its insertion in the bore hole in the bone. A guide wire which usually has been previously inserted for guiding a surgical tool e.g. a drill bit for drilling a bore hole in the bone and the implant has then to be removed. In many cases the guide wire has perforated into the joint leaving a channel between the femoral head and the articulation surfaces. This problem of bone cement advancing into the joint is not yet solved.

An irrigation procedure is often applied in order to prepare the bone tissue prior to the bone cement insertion. Exemplarily, an irrigation procedure of vertebral bodies prior to bone cement injection has been proven to be beneficial in terms of reduction of the injection forces, increase of the maximum bone cement volume and removal of fat for preventing fat embolisms.

2. Description of the Related Art

A cannula for introducing a bone cement mixture is known from US-A 2009/0157085 MELSHEIMER. A lumen is formed through the cannula for advancing the bone cement mixture to the distal portion of the cannula. The distal portion of the cannula is provided with a tip member and with a side aperture proximal to said tip member. The tip member directs the advancement of the bone cement mixture through the side aperture while

preventing advancement of the bone cement mixture axially through the distal end of the cannula. However, this known cannula comprises a proximal portion with an enlarged diameter so that the cannula could not be used as a guide wire for a surgical instrument, tool or an implant.

What is therefore needed is an improved device and a method for augmentation of an implant or for irrigation of bone tissue and subsequent injection of bone cement without the requirement of removing a cannula in order to position a guide wire.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a device suitable to be used for irrigation of the bone tissue and/or injection of bone cement which can be used as a guide wire for surgical instruments, tools and/or an implant.

Another object of the invention is to provide a kit for irrigation of bone tissue and simultaneous removal of irrigation fluid and subsequent insertion of bone cement.

A further object of the invention is to provide a method for irrigation of bone tissue with simultaneous removal of irrigation fluid and subsequent insertion of bone cement by using a kit according to the invention.

Yet another object of the invention is to provide a method for augmenting an implant by using the cannula according to the invention.

The invention solves the posed problem with a cannula displaying the features of claim 1, with a kit for irrigating bone tissue and subsequent injection of bone cement displaying the features of claim 13 or 17, to a method for augmenting an implant for an improved fracture fixation displaying the features of claim 21 as well as to a method for irrigation of bone tissue and subsequent injection of a bone cement displaying the features of claim 24.

The advantages achieved by the cannula according to the invention are essentially to be seen therein that:

- the cannula can be used as a guide wire for a surgical instrument or tool or for an implant;
- a liquid jet irrigation through the cannula can be performed in a bone portion to prepare the bone tissue for a subsequent application of bone cement;
- the cannula allows to replace a guide wire used for placing a bone cement injection device or an implant or tool;
- the injection of bone cement can be performed without removing the cannula so that after injection of the bone cement an implant can be inserted over the cannula into the cement volume or an implant can be inserted prior to bone cement application (e.g. a perforated blade for the proximal femur);
- the cannula can be used for injection of bone cement so that an advancement of bone cement into the articulation area cannot occur because of blocking the channel with the cannula;
- the cannula can be advanced through the bone tissue without the need of additional drilling tools;
- the cannula can be used as a drill bit; and
- the cannula can be used as a probe for assessing bone quality.

Said coupling portion of said cannula can be configured, e.g. as a cone for an attachment of a syringe, jet irrigation device or comparable tool. If said coupling portion has a non-circular cross-section said diameter is to be interpreted as the diameter of the circular cylindrical envelope.

In a special embodiment said coupling portion has a length C measured from said proximal end of said cannula wherein the ratio C / L between said length C and said overall length L of said cannula amounts to maximum 0.1, preferably maximum 0.05.

In a further embodiment said tip portion comprises a coaxial core and a fixation structure radially protruding from said core suitable to anchor said cannula in a bone. An advantage of this configuration is that the cannula can be firmly anchored with its tip portion in a bone allowing to use the cannula as a guide wire for a surgical instrument or tool or for an implant.

In another embodiment said tip portion has a length A wherein the ratio A / L between said length A and said overall length L of said cannula is maximum 0.38, preferably maximum 0.025.

In yet another embodiment said fixation structure is formed by at least one blade or a lamella extending transversely to said central axis. A so configured fixation structure allows a firm anchorage of the cannula in the bone. In a further embodiment said fixation structure is a helical blade, or a helical lamella or an external thread. The cannula can then be inserted in the bone in a screw-like manner. The diameter of the tip portion including the fixation structure can be equal or greater than the diameter of the shaft of the cannula. Further, said fixation structure can comprise two or more blades or lamellae which are offset relative to each other in a direction parallel to said central axis. By means of this configuration of the fixation structure the rigidity of the anchorage of the cannula in the bone can be improved.

In a further embodiment said tip portion comprises a tip which is terminally arranged at said distal end of said cannula and which comprises a plurality of cutting edges. The tip can be configured as a pyramid like spike including three or four cutting edges or can be configured as a drill tip. The aforementioned configuration of the tip of the cannula allows the advantage that the cannula can be advanced into the bone without the need of additional drilling tools. Furthermore, the cannula can be used as a drill.

In another embodiment said length A is maximum 30 mm, preferably maximum 8 mm. The overall length of the cannula is maximum $L = 400$ mm, preferably maximum $L = 320$ mm, while the minimum for the overall length amounts to $L = 80$ mm.

In again another embodiment said at least one radial perforation is located within an axial range with a length B measured from said front end of said shaft wherein the ratio between said length B and said overall length L is maximum 0.5, preferably maximum 0.038. A maximum value for the length is $B = 40$ mm, preferably maximum $B = 12$ mm.

In still a further embodiment said tip portion is self-drilling. The tip portion can comprise a terminal section configured as a drill bit. Additionally, the tip can comprise an axial opening.

In another embodiment said fixation structure is self-cutting.

In yet another embodiment said tip portion axially closes said lumen in said shaft. Further, said tip is preferably acuminate.

Said shaft can be prismatic or cylindrical, preferably circular cylindrical. A circular cylindrical shape offers the advantage that the cannula can be used as a guide wire for an instrument, tool or an implant.

In again another embodiment said cannula comprises a plurality of perforations. Said perforations are arranged angularly symmetrically or angularly asymmetrically when viewed in cross sections orthogonal to said central axis. Said perforations can be arranged in a plurality of planes orthogonal to said central axis, preferably with a parallel orientation with each other. This configuration allows the advantage that a directed irrigation is possible by turning the cannula towards a desired direction. Said perforations can be staggeredly arranged. The outer diameter of said cannula is maximum 8 mm, preferably maximum 3.5 mm.

In a further embodiment said shaft has a constant diameter d_s and a smooth surface between said coupling portion and said front end of said shaft.

The advantage achieved by the kit for irrigating bone tissue and subsequent injection of bone cement according to the invention is essentially to be seen therein that the cannula can slide and rotate within the outer tube in order to adjust the direction and position of the jet lavage. The difference between the inner width D_i of the through hole and the outer diameter d_s of the cannula is preferably in a range between 0.2 mm and 4 mm, and typically 0.9 mm. Typically the outer diameter of the cannula is 2.6 mm and the diameter of the through hole is 3.5 mm. The channel between the outer peripheral wall of said cannula and the inner wall of said outer tube can be used for either:

- A) Suction of irrigation fluid;
- B) Insertion of irrigation fluid; or
- C) Injection of a bone cement.

The assembly of said sleeve and said cannula may be used as follows:

- D) insertion of irrigation fluid via the lumen of said cannula;
- E) simultaneous removal of fluid via the sleeve; and
- F) subsequent application of bone cement via the sleeve.

In a further embodiment of said kit said outer tube comprises a lateral aperture. Therewith the advantage can be achieved that the bone cement will mainly advance through the lateral aperture because the axial way will be blocked by compacted bone tissue. An advantage of an axially open outer lumen is the possible motion between the cannula and the outer tube at the tip. If e.g. blood clots block the channel during suction, a short movement of the assembly could remove this blockage. The outer tube can comprise two or more lateral openings.

In another embodiment said kit further comprises an inner tube axially displaceably arranged in said through hole of said outer tube and comprising a central through bore for rotatively and slideably receiving said cannula. An advantage of this configuration is that the inner tube fitting in between said cannula and said outer tube allows to remove bone tissue, blocking the channel between the wall of the through channel of said outer tube and the peripheral wall of said cannula.

In again another embodiment said kit further comprises an adaptor with a through opening with an enlarged section connectable to said outer tube in fluid communication with said through hole of said outer tube and having an aspiration port in fluid connection with said through opening.

Further advantages that can be achieved by the kit according to the invention are essentially that:

- an irrigation of the bone tissue can be performed through the cannula and the suction of the flushing fluid can be realized via the channel in-between the cannula and the bone cement injection sleeve; and
- the instruments used during this surgical procedure as well as the necessary steps for performing said surgical procedure can be reduced to a minimum.

Due to a configuration with an acuminate tip a means can be provided that allows to advance the cannula into the bone tissue in order to anchor the cannula in the bone.

In another embodiment the method for augmenting an implant for an improved fracture fixation further comprises the step of measuring the bone quality before injecting a bone cement through said lumen in said cannula. The cannula is clamped on its outer surface by the standard guide wire insertion clamp which is normally attached to a power tool. The electric current consumption of the power tool during insertion might then provide information about the bone quality. Otherwise a torque measurement means could be attached instead of the power tool. When measuring the bone quality at a different position with a second device, the information about the bone quality at the exact aimed implant position can not be provided which is the advantage of the proposed method.

In again another embodiment the method further comprises the step of irrigating the bone tissue surrounding said cannula by pressing a washing liquid through said lumen of said cannula before injecting a bone cement through said lumen in said cannula. No suction of the washing liquid is required because the removed fat volume is low in case of an application of the cannula for augmentation of an implant.

A BRIEF DESCRIPTION OF THE DRAWINGS

Several embodiments of the invention will be described in the following by way of example and with reference to the accompanying drawings in which:

Fig. 1 illustrates a longitudinal section of an embodiment of the cannula according to the invention;

Fig. 2 illustrates a front view of the embodiment of the cannula according to fig. 1;

Fig. 3 illustrates a front view of a further embodiment of the cannula according to the invention;

Fig. 4 illustrates a longitudinal section of an embodiment of the kit according to the invention;

Fig. 5 illustrates a longitudinal section of another embodiment of the kit according to the invention;

Fig. 6 illustrates a longitudinal section of an adaptor used with an embodiment of the kit according to the invention; and

Fig. 7 illustrates a perspective view of the adaptor of fig. 6.

An embodiment of the cannula 1 is illustrated in figs. 1 and 2 wherein said cannula 1 comprises a cylindrical shaft 11, a tip portion 14 and a coupling portion 15. Said cannula 1 has an overall length L, a central axis 6, a proximal end 3 and a distal end 4. Said shaft 11 has a smooth peripheral surface and comprises a rear end 18, a front end 19 and a lumen 2 extending between said rear end 17 and said front end 19. Further, said shaft 11 includes a plurality of radial perforations 7. Said coupling portion 15 has a length C, is cylindrically shaped and terminally arranged at said proximal end 3 of said cannula 1 so that a surgical tool or instrument can be connected to said cannula 1. Said shaft 11 has a constant diameter d_s between said coupling portion 15 and said front end 19 and said coupling portion 15 has a diameter d_c which is equal to said diameter d_s of said shaft 11. Said tip portion 14 extends from said front end 19 of said shaft 11 coaxially to said central axis 6 and comprises an acuminate tip 5 which is configured as a pyramid-like spike with four cutting edges 12 (fig. 2) which are arranged at equal angles with respect to each other measured about said central axis 6. Furthermore, said tip portion 14 is solid so that said cannula 1 is axially closed at said front end 19 of said shaft 11. Said tip portion 14 extends over an axial length A and comprises an external thread 17. Said external thread forms a fixation means with a coaxial core 13 and a fixation structure 9 radially protruding from said core 13 so that said cannula 1 can be firmly anchored in a bone. In the present embodiment the outer diameter of said tip portion 14 is equal to the diameter d_s of said shaft 11. Said plurality of radial perforations 7 is located within an axial range with a length B measured from said front end 19 of said shaft 11. Further, said radial perforations 7 are located at different distances measured from said front end 19 of said shaft 11 and are arranged at equal angles relative to each other measured orthogonal to said central axis 6 of said cannula 1.

Another configuration of the tip portion 14 is illustrated in fig. 3. The tip portion 14 of fig. 3 differs from the tip portion 14 of fig. 2 only therein that it comprises three cutting edges

12 instead of four cutting edges 12. Similarly, said three cutting edges 12 are arranged at equal angles with respect to each other measured about said central axis 6.

Fig. 4 illustrates an embodiment of the kit for irrigating bone tissue and subsequent injection of bone cement including the cannula of figs. 1 and 2 and an outer tube 20 with a through hole 21 of diameter D_i for injection of bone cement. Said cannula 1 is rotatably and axially displaceably arranged in said through hole 21. Further, said outer tube 20 comprises a lateral aperture 22 wherethrough a bone cement injected through said through hole 21 will mainly advance. The channel 23 between the outer peripheral wall 10 of said cannula 1 and the inner wall 24 of said outer tube 20 can be used for either suction of irrigation fluid, insertion of irrigation fluid or injection of bone cement.

Fig. 5 illustrates a further embodiment of the kit which differs from the embodiment of fig. 4 only therein that said kit further comprises an inner tube 25 which is axially displaceably arranged in said through hole 21 of said outer tube 20. Further, said inner tube 25 comprises a central through bore 26 for rotatively and slideably receiving said cannula 1. Said inner tube 25 fits in between said cannula 1 and said outer tube 20.

Figs. 6 and 7 illustrate an adaptor 30 to be used in another embodiment of the kit according to the invention. Said adaptor 30 essentially comprises a first end 31, a second end 32 and a through opening 33 extending between said first and second end 31, 32. Said through opening 33 has a longitudinal axis 37, a coaxial first section 34 for guiding said cannula 1 and a coaxial second section 35 with a larger diameter which is suitable for fluid connection with the through hole 21 of said outer tube 20 (not shown). An aspiration port 36 is arranged transversely to said longitudinal axis 37 and in fluid connection with said second section 35 of said through opening 33. Said second section 35 of said through opening 33 comprises a female Luer-Lock connector 40 at said second end 32 of said adaptor 30 which is connectable to a male Luer-Lock connector at the rear end 27 of said outer tube 20. A first sealing 38 is arranged between said second end 32 of said connector 30 and said outer tube 20 to provide a fluid tight transition between said adaptor 30 and said outer tube 20. A second sealing 39 is arranged in said first section 34 of said through hole 33 encircling said cannula 1 to provide a fluid tight closing of said through opening 33 towards said first end 31 of said adaptor 30. Further, said aspiration port 36 comprises a fastening means, e.g. in the

form of an internal thread 41 to reversibly fix an aspiration tube thereto. In the present embodiment said coupling portion 15 of said cannula 1 is configured as a cone 16 tapering towards said proximal end 3 of said shaft 11. Said conical coupling portion is used for an attachment of a jet irrigation device.

The above configuration of said adaptor 30 allows to connect an irrigation source (not shown) to the coupling portion 15 of said cannula 1 in such a manner that the irrigation fluid can be pressed through the lumen 2 of said cannula 1. A fluid suction source can be connected to said aspiration port 36 allowing to simultaneously remove the suction fluid from the irrigated bone through said through hole 21 of said outer tube 20 and through said aspiration port 36.

In a first method for augmenting an implant for an improved fracture fixation said cannula 1 is used to perform the steps of:

- a) injecting a bone cement through said lumen 2 in said cannula 1 after having inserting said cannula 1 into a selected portion of a bone; and
- b) positioning an implant over said cannula 1 into the bone cement volume injected under the previous step wherein said cannula 1 is used as a guide wire for said implant.

Depending on the implant and the surgeons requirements the above steps can be performed in a different sequence so that firstly – after having the cannula 1 inserted into a selected portion of a bone – an implant is positioned over said cannula 1 into said bone by using said cannula as a guide wire and secondly a bone cement is injected through lateral perforations in said implant.

Finally, said cannula 1 is removed.

The above step b) can be performed before step a) due to safety issues. Many surgeons believe that it is absolutely necessary to firstly insert the implant and then the cement to exclude the case of missing the implant insertion during the hardening time of the cement. This however requires then special implants like a perforated blade or screw.

In another method for irrigation of bone tissue and subsequent injection of a bone cement, particularly in case of vertebroplasty an embodiment of said kit is used to perform the following steps:

- 1) inserting said cannula 1 into a selected portion of a bone forming a hole in said bone;
- 2) inserting said inner tube 25 into said through hole 21 of said outer tube 20;
- 3) advancing said outer tube 20 together with said inner tube 23 over said cannula 1 into a cavity in a bone using said cannula 1 as a guide wire;
- 4) removing said inner tube 25;
- 5) irrigating the bone tissue surrounding said cannula 1 by pressing a washing liquid through said lumen 2 of said cannula 1;
- 6) sucking off the washing liquid through said through hole 21 in said outer tube 20 simultaneously to irrigating said bone tissue by means of said cannula 1;
- 7) removing said cannula 1;
- 8) injecting a bone cement through said through hole 21 in said outer tube 20; and
- 9) removing said outer tube 20.

While various descriptions of the present invention are described above, it should be understood that the various features can be used singly or in any combination thereof. The scope of the present invention is accordingly defined as set forth in the appended claims.

What is claimed is:

1. A cannula (1) with a central axis (6), a proximal end (3), a distal end (4) and an overall length L including:

A) a shaft (11) comprising a rear end (18), a front end (19), a lumen (2) extending through said shaft (11) and at least one radial perforation (7);

B) a tip portion (14) coaxially extending from said front end (19) of said shaft (11) and including a cutting edge (12); and

C) a coupling portion (15) terminally arranged at said proximal end (3) of said cannula (1) and extending to said rear end (18) of said shaft (11) suitable for being connected to a surgical tool or instrument;

wherein

D) said shaft (11) has a diameter d_s and said coupling portion (15) has a maximum diameter d_c which is equal or smaller than said diameter d_s of said shaft (11).

2. The cannula (1) according to claim 1, wherein said coupling portion (15) has a length C measured from said proximal end (3) of said cannula (1) and wherein the ratio C / L between said length C and said overall length L of said cannula (1) amounts to maximum 0.1, preferably maximum 0.05.

3. The cannula (1) according to claim 1 or 2, wherein said tip portion (14) comprises a coaxial core (13) and a fixation structure (9) radially protruding from said core (13) suitable to anchor said cannula (1) in a bone.

4. The cannula (1) according to one of the claims 1 to 3, wherein said tip portion (14) has a length A and wherein the ratio A / L between said length A and said overall length L of said cannula (1) is maximum 0.38, preferably maximum 0.025.

5. The cannula (1) according to claim 3 or 4, wherein said fixation structure (9) is formed by at least one blade or a lamella extending transversely to said central axis (6).

6. The cannula (1) according to one of the claims 1 to 5, wherein said tip portion (14) comprises a tip (5) which is terminally arranged at said distal end (4) of said cannula (1) and which comprises a plurality of cutting edges (12).

7. The cannula (1) according to one of the claims 4 to 6, wherein said length A is maximum 30 mm, preferably maximum 8 mm.

8. The cannula (1) according to one of the claims 1 to 7, wherein said at least one radial perforation (7) is located within an axial range with a length B measured from said front end (19) of said shaft (11) and wherein the ratio between said length B and said overall length L is maximum 0.5 , preferably maximum 0.038 .

9. The cannula (1) according to one of the claims 1 to 8, wherein said tip portion (14) is self-drilling.

10. The cannula (1) according to one of the claims 1 to 9, wherein said fixation structure (9) is self-cutting.

11. The cannula (1) according to one of the claims 1 to 10, wherein said tip portion (14) axially closes said lumen (2) in said shaft (11).

12. The cannula (1) according to one of the claims 1 to 11, wherein said shaft (11) has a constant diameter d_s and a smooth surface between said coupling portion (15) and said front end (19) of said shaft (11).

13. A kit for irrigating bone tissue and subsequent injection of bone cement using a cannula according to one of the claims 1 to 12 and comprising an outer tube (20) with a through hole (21) for injection of bone cement, wherein said cannula (1) is rotatably and axially displaceably arranged in said through hole (21).

14. The kit according to claim 13, wherein said outer tube (20) comprises a lateral aperture (22).

15. The kit according to claim 13 or 14, wherein said kit further comprises an inner tube (25) axially displaceably arranged in said through hole (21) of said outer tube (20) and comprising a central through bore (26) for rotatively and slideably receiving said cannula (1).

16. The kit according to one of the claims 13 to 15, wherein said kit further comprises an adaptor (30) with a through opening (33) with an enlarged section connectable to said outer tube (20) in fluid communication with said through hole (21) of said outer tube (20) and having an aspiration port 36 in fluid connection with said through opening (33).

17. A kit for irrigating bone tissue and subsequent injection of bone cement comprising:

a) a cannula (1) including:

- i) a central axis (6), a proximal end (3) and a distal end (4) with an acuminate tip (5);
- ii) a lumen (2) which is axially closed at said tip (5);
- iii) at least one radial perforation (7); and

b) an outer tube (20) comprising a through hole (21) for receiving said cannula (1).

18. The kit according to claim 17, wherein said kit further comprises an inner tube (25) axially displaceably arranged in said through hole (21) of said outer tube (20) and comprising a central through bore (26) for rotatively and slideably receiving said cannula (1).

19. The kit according to claim 17 or 18, wherein said kit further comprises an adaptor (30) with a through opening (33) with an enlarged section connectable to said outer tube (20) in fluid communication with said through hole (21) of said outer tube (20) and having an aspiration port 36 in fluid connection with said through opening (33).

20. Use of a cannula (1) according to one of the claims 1 to 12 as a guide wire for an instrument, tool or and/or an implant to be inserted in a bone.

21. Method for augmenting an implant for an improved fracture fixation by using a cannula (1) according to one of the claims 1 to 12 comprising the following steps:

- i) inserting said cannula (1) into a selected portion of a bone forming a hole in said bone;
- ii) injecting a bone cement through said lumen (2) in said cannula (1);
- iii) positioning an implant over said cannula (1) into the bone cement volume injected under step ii); and
- iv) removing said cannula (1),

wherein

said step iii) of positioning an implant over said cannula (1) can be performed before said step ii) of injecting a bone cement through said lumen (2) in said cannula (1).

22. The method according to claim 21, further comprising the step of measuring the bone quality before injecting a bone cement through said lumen (2) in said cannula (1).

23. The method according to claim 21 or 22, further comprising the step of irrigating the bone tissue surrounding said cannula (1) by pressing a washing liquid through said lumen (2) of said cannula (1) before injecting a bone cement through said lumen (2) in said cannula (1).

24. A Method for irrigation of bone tissue and subsequent injection of a bone cement, particularly in case of vertebroplasty by using a kit according to one of the claims 13 to 19 comprising the following steps:

- a) inserting said cannula (1) into a selected portion of a bone forming a hole in said bone;
- b) inserting said inner tube (25) into said through hole (21) of said outer tube (20);
- c) advancing said outer tube (20) together with said inner tube (23) over said cannula (1) into a cavity in a bone using said cannula (1) as a guide wire;
- d) removing said inner tube (25);
- e) irrigating the bone tissue surrounding said cannula (1) by pressing a washing liquid through said lumen (2) of said cannula (1);
- f) sucking off the washing liquid through said through hole (21) in said outer tube (20) simultaneously to irrigating said bone tissue by means of said cannula (1);
- g) removing said cannula (1)
- h) injecting a bone cement through said through hole (21) in said outer tube (20);
and
- i) removing said outer tube (20).

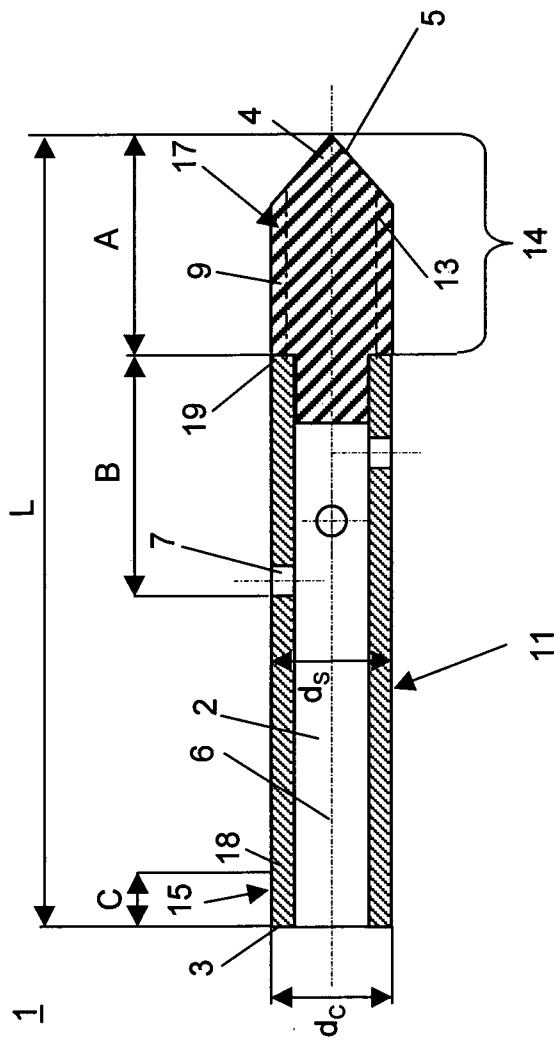


Fig. 1

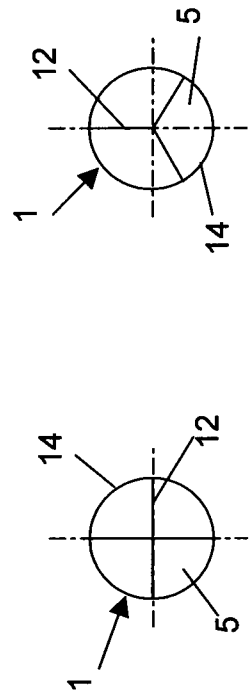


Fig. 2

Fig. 3

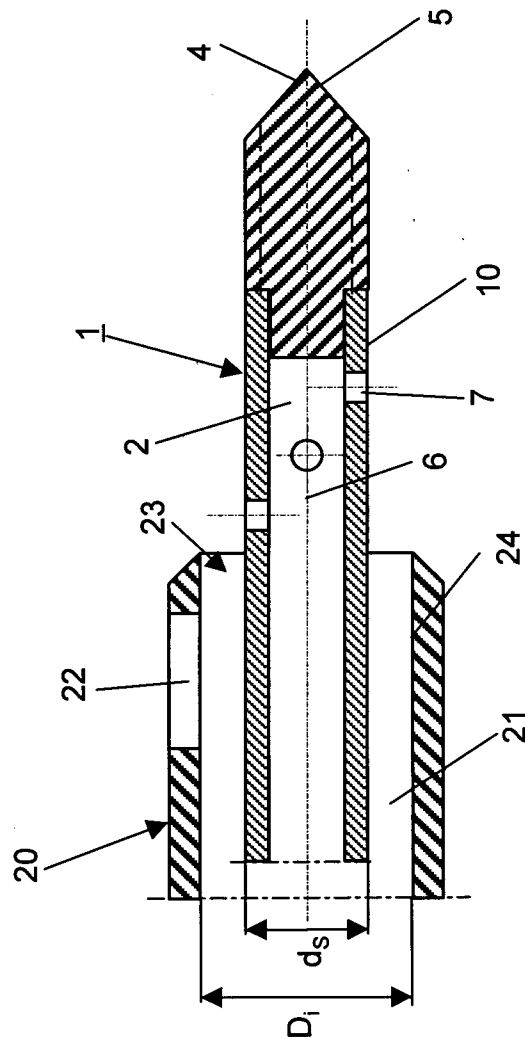


Fig. 4

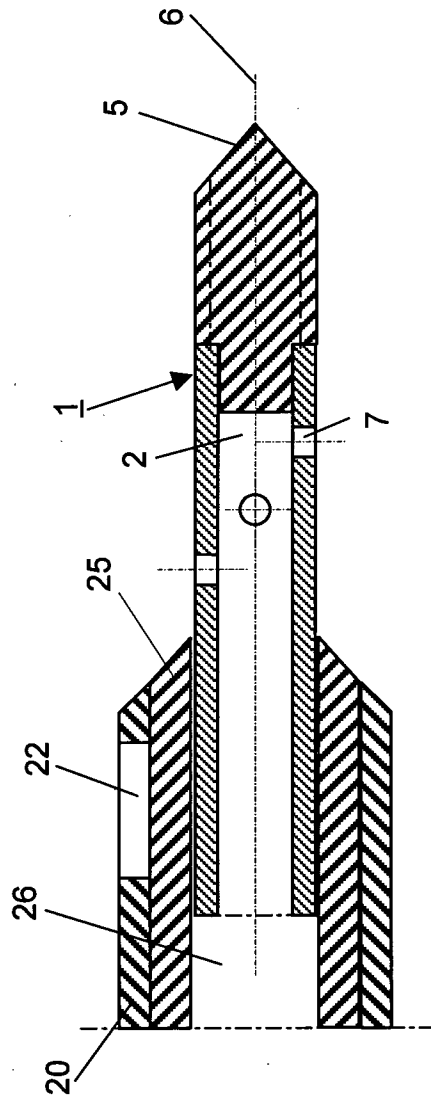


Fig. 5

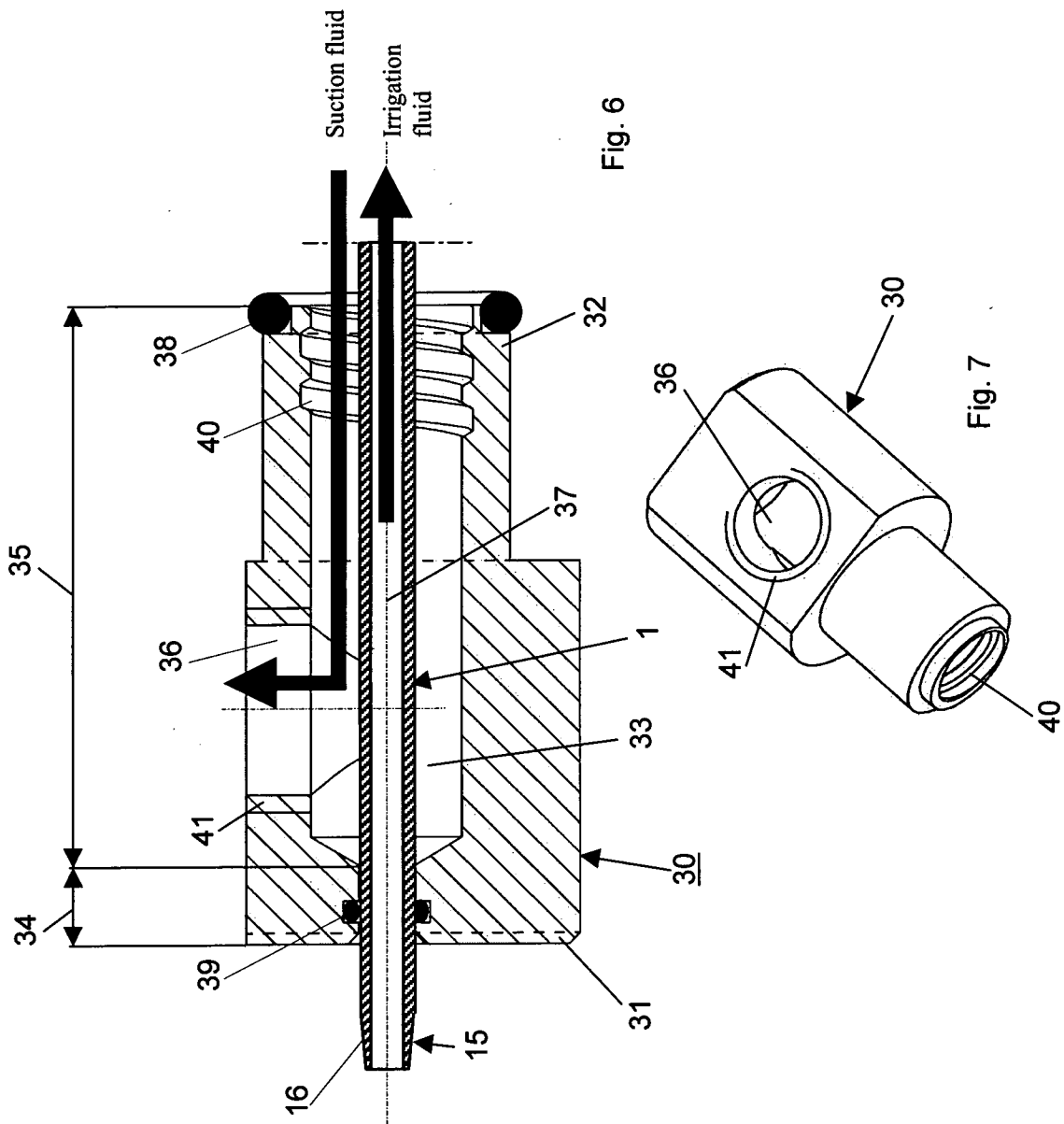


Fig. 6

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/CH2010/000007A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/88 A61F2/46

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)
A61B A61F A61M

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/142842 A1 (KRUEGER JOHN A [US] ET AL) 21 June 2007 (2007-06-21) page 4, paragraph 43 - page 6, paragraph 60 figures 2A, 3D, 4, 6A, 10	1,2,4, 6-8, 10-12
X	WO 2007/122608 A2 (DISC O TECH MEDICAL TECHNOLOGI [IL]; BEYAR MORDECHAY [IL]; GLOBERMAN O) 1 November 2007 (2007-11-01) page 9, lines 21-32 page 11, lines 19-31 page 13, line 7 - page 14, line 26 figures 6A-6C ----- -/--	1,2,4, 6-12

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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.

"&" document member of the same patent family

Date of the actual completion of the international search

27 September 2010

Date of mailing of the international search report

08/12/2010

Name and mailing address of the ISA/

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Authorized officer

Kakoullis, Marios

INTERNATIONAL SEARCH REPORT

International application No

PCT/CH2010/000007

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/198243 A1 (MELSHEIMER JEFFRY S [US]) 6 August 2009 (2009-08-06) page 2, paragraph 44 - page 3, paragraph 52 page 4, paragraph 66 - page 5, paragraph 67 figures 6, 7a, 8b-8d, 11, 12a-12d -----	1-8, 10-12
A	WO 02/34148 A2 (KYPHON INC [US]; RALPH CHRISTOPHER R [US]; LAYNE RICHARD W [US]; SAND) 2 May 2002 (2002-05-02) page 10, line 21 - page 11, line 10 page 12, line 3 - page 13, line 14 page 14, line 9 - page 16, line 1 page 16, line 17 - page 18, line 10 page 21, line 35 - page 22, line 31 figures 9, 10a -----	1-4,7,8, 11,12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CH2010/000007

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.: 20-24
because they relate to subject matter not required to be searched by this Authority, namely:
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
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 additional sheet

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 an 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.:

see annex

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-12

The cannula according to claim 1, wherein said tip portion comprises a coaxial core and a fixation structure radially protruding from said core suitable to anchor said cannula in a bone.

2. claim: 14(completely); 13(partially)

A kit for irrigating bone tissue and subsequent injection of bone cement using a cannula according to claim 1 and comprising an outer tube with a through hole for injection of bone cement, wherein said cannula is rotatably and axially displaceably arranged in said through hole.

3. claims: 17, 18(completely); 15(partially)

A kit for irrigating bone tissue and subsequent injection of bone cement comprising, inter alia, an inner tube axially displaceably arranged in said through hole of said outer tube and comprising a central through bore for rotatively and slideably receiving said cannula.

4. claims: 16, 19(all partially)

An adaptor with a through opening with an enlarged section connectable to said outer tube in fluid communication with said through hole of said outer tube and having an aspiration port in fluid connection with said through opening.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/CH2010/000007

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