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(54) **DEVICE FOR MINI-INVASIVE ULTRASOUND TREATMENT OF DISC DISEASE**

GERÄT ZUR MINIMALINVASIVEN ULTRASCHALLBEHANDLUNG VON BANDSCHEIBENERKRANKUNGEN

DISPOSITIF DE TRAITEMENT MINI-INVASIF PAR ULTRASONS DE LA PATHOLOGIE DU DISQUE INTERVERTEBRAL

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Description

[0001] The present invention relates to a device for mini-invasive ultrasound treatment of disc disease, wherein at least one therapeutic ultrasound transducer is provided for treatment of the disc, preferably nucleus pulposus, of a patient by generating by means of said therapeutic ultrasound transducer an ultrasonic field, the temperature focus of which is located in the disc, preferably nucleus pulposus, for heating thereof.

[0002] The intervertebral disc consists of an outer fibrous tissue ring, anulus fibrosus, and an inner, more viscous part, nucleus pulposus. The disc functions as a shock absorber and if anulus fibrosus breaks, e.g. a small fissuring, disc matter may find its way out and cause a compression of nerve roots and induce an inflammatory reaction.

[0003] Prolapsed intervertebral discs have been treated surgically since the thirties by removal of the displaced disc matter and/or a part of the bulging disc. Later, the surgical treatment has developed towards less invasive operations and now, microscopes and percutaneous techniques are used for removing disc matter. An alternative method for surgical treatment is chemonucleolys, where the enzyme chymopapain is injected into nucleus pulposus, the central part of the disc. The enzyme polymerizes the long proteoglycan chains in nucleus pulposus with subsequent loss of the hygroscopicity. This reduces the volume and pressure in nucleus pulposus and the bulging part of the disc, which explains the pain relief patients with sciatica experience after chemonucleolys. The method has proven to give pain relief in 75 per cent of the cases and has a well documented cost efficiency. Unfortunately, the method has caused serious allergic reactions in about 1 per cent of the cases. Next step in the development could be a non-invasive treatment or therapy of prolapsed intervertebral discs, which preferably should be painless, avoid the risk for infections and carried through ambulatory.

[0004] A method for thermotherapy and coagulation of tissue involves use of focused ultrasound with high intensity. The ultrasound pass well through soft tissue and can be focused on remote spots within a surface of a few millimeters. The energy absorption in the tissue increases the temperature with a sharp temperature gradient such that the boundaries of the treated volume are clearly limited without causing any damages on the surrounding tissue (US 5 291 890, US 5 501 655). Ultrasound treatment or therapy of prolapsed intervertebral discs is previously known (EP 0 872 262).

[0005] Heat treatment or thermotherapy of discs has proven successful in a method called IDET (US 6 073 051, US 6 007 570, US 5 980 504). The method has as its aim to insert a catheter into the disc by means of a cannula. Farthest out on the catheter there is a spool which is heated by applying a radio frequency voltage thereon (US 5 785 705). The heat is increased to about 90°C in nucleus pulposus where the heating element of the catheter has been located and treatment or therapy is carried through for about 15 minutes.

[0006] Surgery with focused ultrasound has several advantages compared with other thermal techniques. In the first place, it is non-invasive, secondly, focus can be made movable and thirdly, the energy can be supplied in a few seconds. The limitation of ultrasound is its absorption in bone and its poor penetration through gas-filled passages. Clinical applications of ultrasound surgery are today mostly used in ophtalmic surgery, urology and oncology. The effect of ultrasound can be divided into thermal and non-thermal effects.

[0007] The thermal effects of ultrasound are caused by absorption of ultrasound in the tissue. This leads to a temperature increase which is dependent on the parameters of the ultrasound (frequency and intensity) and the acoustic properties of the tissue. The absorption of ultrasound in musculoskeletal tissues increases with the apatite and protein content, which means high absorption in bone, cartilage, tendons and ligaments. Water however, has a low ultrasound absorption capacity and can for this reason be used as an acoustic medium between the ultrasound transducer and the tissue. Higher absorption can be expected in anulus fibrosus (high collagen content) than in nucleus pulposus (high water content). This will lead to higher temperatures in the outer part of the intervertebral disc than in the central part. In order to avoid that the temperature in anulus fibrosus exceeds a detrimental level at the same time as the temperature in nucleus pulposus reaches a sufficient level, the ultrasound can be transmitted from several ultrasound sources. In this manner, the fields will overlap each other and increase the effect in nucleus pulposus at the same time as the intensity in the surrounding tissue including anulus fibrosus can be kept low.

[0008] The object of the present invention has been to facilitate, at the abovementioned devices, location of the temperature focus of the ultrasonic field of the ultrasound transducer on a desired point in the disc, preferably in nucleus pulposus. This is arrived at according to the invention by means of a device having the characterizing features of subsequent claim 1.

[0009] By means of the device defined in the claims, it is achieved that the temperature focus of the ultrasonic field of the therapeutic ultrasound transducer can be located and maintained on the desired point in the disc, preferably in nucleus pulposus.

[0010] The invention will be further described below with reference to the accompanying drawings, in which

fig. 1 schematically illustrates a structural embodiment of the device according to the invention;
fig. 2 schematically illustrates a therapeutic ultrasound transducer forming part of the device according to fig. 1; and
fig. 3 schematically illustrates a calibrating device which may form part of a device according to fig. 1.

[0011] The treatment device 1 schematically illustrated in fig. 1 is adapted to generate, by means of a therapeutic ultrasound transducer 2 (so called therapeutic transducer), an ultrasonic field 3, the temperature focus F of which is intended to be located in the intervertebral disc 5, preferably in nucleus pulposus 6, of the patient 4 for treatment thereof. The therapeutic ultrasound transducer 2 comprises a plurality of, preferably three or more position transmitters 7 for determining its position.

[0012] The therapeutic ultrasound transducer 2 is adapted to be inserted through the patient's 4 skin and engage the disc 5, preferably anulus fibrosus 8, to provide a local temperature increase in nucleus pulposus 6 so that enzymes such as collagenase present in the disc are activated and cause decomposition of collagen and proteoglycanes, which results in shrinking of nucleus pulposus 6 primarily because of less hygroscopicity. The therapeutic ultrasound transducer 2 can be placed against the disc 5 without perforating anulus fibrosus 8 and thereby transmit the ultrasonic field 3 focused in temperature focus F towards the treatment volume. The transmitter element 9 of the therapeutic ultrasound transducer 2, e.g. a piezoelectric element, may be cooled with water for cooling the crystal and the tissue closest to the therapeutic ultrasound transducer 2 in a similar way as one today does in microwave therapy of cancer in the prostate gland (US 5 964 791).

[0013] In order to provide said cooling, the therapeutic ultrasound transducer 2 is provided at its distal end 10 with at least one cooling chamber 11 with cooling liquid 12. This cooling chamber 11 is located between the transmitter element 9 and a membrane-like wall 13 of such flexible material that said wall is able to adapt to the surface of anulus fibrosus 8 when it is brought in contact therewith.

[0014] The therapeutic ultrasound transducer 2 further comprises at least one temperature sensor 14 for measuring the temperature before and/or during treatment. In order to increase the volume of therapy or treatment, the direction or setting of the therapeutic ultrasound transducer 2 can be varied such that temperature focus F is scanned over a larger area. The temperature sensor 14 is provided to measure the temperature at the inner side of the flexible wall 13 and it is preferably connected to said wall 13 such that it follows the wall 13 when said wall is deformed when brought in contact with the surface of anulus fibrosus 8.

[0015] The cooling liquid 12 is preferably water which is distributed through an inlet passage 15 to the cooling chamber 11 and through an outlet passage 16 therefrom such that the water can circulate through the cooling chamber 11. A sealing means 17 is provided within the transmitter element 9 for preventing cooling liquid 12 from finding its way out of the cooling chamber 11.

[0016] In more detail, the therapeutic ultrasound transducer 2 is adapted to cause a local temperature increase in nucleus pulposus 6 so that enzymes such as collagenase present in the disc 5, are activated and cause decomposition of collagen and proteoglycanes, which results in shrinking of nucleus pulposus 6 primarily because of less hygroscopicity.

[0017] The treatment device 1 may comprise a rigid tube 18 with associated inner portion and several position transmitters 19, preferably three such transmitters. The tube 18 may, by means of optical navigation technique, be inserted dorsolaterally towards the disc 5. The inner portion of the tube 18 is then replaced by the therapeutic ultrasound transducer 2 and said tube 18 is schematically illustrated in fig. 1 with broken lines.

[0018] The treatment device 1 also comprises an optical navigating device 20 to navigate the therapeutic ultrasound transducer 2 (US 5 772 594). This optical navigating device 20 comprises at least one diagnostic camera 21 which is adapted to produce at least one picture or image of the anatomic structure 23 of the treatment area 22 in a monitor 24. The diagnostic camera 21 may be an X-ray camera 25 taking two pictures of the anatomic structure 23 of the treatment area 22 from different directions with preferably a 90° intermediate angle and showing or displaying these in the monitor 24. At the optical navigating device 20, the X-ray camera 25 is used together with an optical analogue-digital-converter for obtaining or producing a real time image or picture in the monitor 24 of the position and direction of the therapeutic ultrasound transducer 2 (US 6 021 343, US 5 834 759, US 5 383 454).

[0019] The X-ray camera 25 comprises a calibrating device 26 - e.g. a calibrating hood - which is located in front of the objective of the X-ray camera 25 and having markers 27 the mutual distances of which are known. The markers 27 may be round and consist e.g. of tantalum.

[0020] The optical navigating device 20 further comprises a reference device 28 which is provided to be attached to the spinous process 30 of a vertebra 29 or in a corresponding position such that it gets a determined or fixed position relative to the treatment area 22. The reference device 28 has several position transmitters 31, namely preferably at least three, and these may consist of metallic material, e.g. tantalum.

[0021] Furthermore, the optical navigating device 20 comprises a signal receiving and/or signal sending unit 32. This includes a suitable number of signal receivers 33, 34 for receiving reflected or other signals from the position transmitters 7 and 31 of the therapeutic ultrasound transducer 2 and the reference device 28 respectively. The signal receiving and/or signal sending unit 32 may eventually comprise one or more signal transmitters 35 for sending or transmitting signals to said position transmitters 7 and 31, which are provided to receive these signals.

[0022] The signals transmitted by the position transmitters 7 and 31 may e.g. be in the form of infrared light and the signal receivers 33, 34 may in such case be receivers of infrared light.

[0023] In the treatment device 1 there may also be included a calibrating unit 37 for calibrating the temperature effect of the temperature focus F of the therapeutic ultrasound transducer 2. The calibrating unit 37 has one or more thermoelements 38 by means of which the effect at said temperature focus F can be measured for calibration. The thermoelements 38 are connected to a schematically illustrated measure instrument 39.

[0024] Prior to treatment of the disc 5, preferably nucleus pulposus 6, the reference device 28 is located on the patient's 4 vertebra 29 and the therapeutic ultrasound transducer 2 is calibrated in the calibrating unit 37.

[0025] Two X-ray pictures are taken of the patient's 4 anatomic structure 23 at the disc 5 and these X-ray pictures are shown on the monitor 24. On these X-ray pictures, the position of the reference device 28 relative to the disc 5 may then be determined by means of the markers 27 of the calibrating device 26.

[0026] During treatment of the disc 5, preferably nucleus pulposus 6, the therapeutic ultrasound transducer 2 is navigated by means of the signal receiving or signal sending unit 32, whereby the navigation is presented in the X-ray pictures or images on the monitor 24. This is accomplished while the position transmitters 7 of the therapeutic ultrasound transducer 2 cooperate through signals with the signal transmitters 33, 34 of the signal receiving or signal sending unit 32. By means of said navigation, the therapeutic ultrasound transducer 2 can be positioned such that the temperature focus F of its ultrasonic field 3 will lie in the disc 5, preferably nucleus pulposus 6. The temperature in the temperature focus F preferably exceeds 45°C.

[0027] The treatment can be automatically interrupted if the patient 4 moves to an incorrect position relative to the therapeutic ultrasound transducer 2 or vice versa.

[0028] The invention is not limited to the embodiment described above, but may vary within the scope of the following claims. Thus, the treated disc 5 may e.g. be any disc in the body.

[0029] The diagnostic camera 21 may be a computerized tomography (CT) scanner which is provided to produce images of said anatomic structure 23 and these images can be processed in a computer program or software for obtaining a 3D-image in the monitor 24.

[0030] The therapeutic ultrasound transducer 2 may be provided to be positioned manually or be located on a positioning device 40 for positioning thereof relative to the disc 5 to be treated.

Claims

1. Device for mini-invasive ultrasound treatment of disc disease, wherein at least ' one therapeutic ultrasound transducer (2) is provided for treatment of the disc (5) of a patient (4) by generating by means of said therapeutic ultrasound transducer (2) an ultrasonic field (3), the temperature focus (F) of which is located in the disc (5) for heating thereof, **characterized in**

   - **that** an optical navigating device (20) comprises at least one diagnostic camera (21) which is adapted to produce at least one picture or image of the anatomic structure (23) of the treatment area (22) within which the disc (5) to be treated is located,
   - **that** the therapeutic ultrasound transducer (2) is provided for insertion through the skin of the patient (4) and engagement of the disc (5)
   - **that** the therapeutic ultrasound transducer (2) at its distal end (10) has a flexible wall (13) with the ability to adapt to the surface of annulus fibrosus (8);
   - **that** at least one cooling chamber (11) for cooling liquid (12) is provided at the distal end (10),
   - **that** at least one ultrasound transmitting element (9) is provided within the cooling chamber (11), the cooling chamber (11) being located between the transmitter element (9) and the flexible wall (13).
   - **that** the cooling chamber (11) with cooling liquid (12) is configured to cool the ultrasound transmitting element (9) and the tissue closest to the ultrasound transducer (2), and
   - **that** at least one temperature sensor (14) is provided to measure the temperature in the disc (5).

2. Device according to claim 1, **characterized in**

   - - **that** the optical navigating device (20) further comprises at least one signal receiving or signal sending unit (32) which is adapted to send signals to and/or receive reflected or other signals from position transmitters (31, 7) on

     a) a reference device (28) which has a set position relative to the disc (5), and
     b) the therapeutic ultrasound transducer (2) such that the position thereof relative to said treatment area (22) can be determined.

3. Device according to claim 2, **characterized in that** cooling liquid (12) is circulated through the cooling chamber (11).

4. Device according to claim 3, **characterized in that** the cooling liquid (12) is water.

5. Device according to any preceding claim, **characterized in that** the temperature sensor (14) is provided to measure the temperature at the inner side of the flexible wall (13).

6. Device according to claim 5, **characterized in that** the temperature sensor (14) is connected to the flexible wall (13) such that it follows said flexible wall (13) during the deformation thereof when said wall is brought in contact with the disc (5).

7. Device according to any of claim 1-6, **characterized in that** a tube (18) with an associated inner portion is dorsolaterally insertable towards the disc (5) and navigatable by means of the optical navigating device (20) and that said inner portion then is replaced by the therapeutic ultrasound transducer (2).

8. Device according to any of claim 1-7, **characterized in that** the diagnostic camera (21) is an X-ray camera (25).

9. Device according to claim 8, **characterized in that** the X-ray camera (25) comprises a calibrating device (26) with markers (27) which are adapted to determine the position of the anatomic structure (23) displayed in a monitor (24) and present at the patient's (4) disc (5).

10. Device according to claim 9, **characterized in that** the monitor (24) is provided to display two X-ray photographs of said anatomic structure (23) taken with the X-ray camera (25) from two different locations.

11. Device according to any of claims 1-7, **characterized in that** the diagnostic camera (21) is a computerized tomography (CT) scanner which is provided to produce images of the anatomic structure (23) at the patient's (4) disc (5), said images being processed in a computer program (software) for obtaining a 3D-image in a monitor (24).

12. Device according to any of claim 1-11, **characterized in that** the signal receiving or signal sending unit (32) is provided to receive or send signals in the form of infrared light and that said position transmitters (7, 31) are provided to send or receive signals in the form of infrared light.

13. Device according to any preceding claim, **characterized in that** the temperature in the temperature focus (F) of the therapeutic ultrasound transducer (2) exceeds 45°C.

14. Device according to any preceding claim, **characterized in that** a calibrating device (26) is provided for calibrating the effect emitted by the therapeutic ultrasound transducer (2) in the temperature focus (F) of said therapeutic ultrasound transducer (2) and/or the position of said temperature focus (F) relative to the ultrasound transmitting element (9) of the therapeutic ultrasound transducer (2).

15. Device according to any of claims 2-14, **characterized in that** the reference device (28) is attached to a vertebra (29) in the patient's vertebral column, preferably to the spinal process (30) of said vertebra (29).

16. Device according to any of claims 2-15, **characterized in that** the reference device (28) comprises position transmitters (31) consisting of metallic balls, preferably tantalum balls.

17. Device according to claim 16, **characterized in that** the signal receiving or signal sending unit (32) of the optical navigating device (20) consists of at least one X-ray device.

Patentansprüche

1. Gerät zur minimalinvasiven Ultraschallbehandlung von Bandscheibenerkrankungen, wobei mindestens ein therapeutischer Ultraschalltransducer (2) zur Behandlung der Bandscheibe (5) eines Patienten (4) bereitgestellt wird, indem mittels des therapeutischen Ultraschalltransducers (2) ein Ultraschallfeld (3) erzeugt wird, wobei dessen Temperaturfokus (F) in der Bandscheibe (5) zu deren Erwärmung lokalisiert wird, **dadurch gekennzeichnet**

   - **daß** eine optische Navigationsvorrichtung (20) mindestens eine diagnostische Kamera (21) umfaßt, die so eingerichtet ist, daß sie mindestens ein Bild oder eine Abbildung der anatomischen Struktur (23) der Behandlungsfläche (22), in der sich die Bandscheibe (5), die behandelt werden soll, befindet, erzeugt,
   - **daß** der therapeutische Ultraschalltransducer (2) zur Einführung durch die Haut des Patienten (4) und Einstellung der Bandscheibe (5) bereitgestellt wird,
   - **daß** der therapeutische Ultraschalltransducer (2) an seinem distalen Ende (10) eine flexible Wand (13) aufweist, die sich an die Oberfläche des Faserringes (8) anpassen kann;
   - **daß** mindestens eine Kühlkammer (11) zum Kühlen von Flüssigkeit (12) an dem distalen Ende (10) bereitgestellt wird,
   - **daß** mindestens ein Ultraschallübertragungselement (9) in der Kühlkammer (11) bereitgestellt wird, wobei sich die Kühlkammer (11) zwischen dem Übertragungselement (9) und der flexiblen Wand (13) befindet,
   - **daß** die Kühlkammer (11) mit der Kühlflüssigkeit (12) so konfiguriert ist, daß sie das Ultraschallübertragungselement (9) und das Gewebe, das sich am dichtesten an dem Ultraschall-

transducer (2) befindet, kühlt, und

- **daß** mindestens ein Temperatursensor (14) bereitgestellt wird, um die Temperatur der Bandscheibe (5) zu messen.

2. Gerät nach Anspruch 1, **dadurch gekennzeichnet**

- **daß** die optische Navigationsvorrichtung (20) ferner mindestens eine Signalempfangs- oder Signalsendeeinheit (32) umfaßt, die so angepaßt ist, daß sie Signale zu den Positionstransmittem (31, 7) sendet und/oder reflektierte oder andere Signale von den Positionstransmittern (31, 7) an

  a) einer Referenzvorrichtung (28), die eine Einstellposition in bezug auf die Bandscheibe (5) aufweist, und
  b) dem therapeutischen Ultraschalltransducer (2) empfängt, so daß seine Position in bezug auf die Behandlungsfläche (22) bestimmt werden kann.

3. Gerät nach Anspruch 2, **dadurch gekennzeichnet, daß** die Kühlflüssigkeit (12) durch die Kühlkammer (11) zirkuliert.

4. Gerät nach Anspruch 3, **dadurch gekennzeichnet, daß** die Kühlflüssigkeit (12) Wasser ist.

5. Gerät nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, daß** der Temperatursensor (14) bereitgestellt wird, um die Temperatur an der Innenseite der flexiblen Wand (13) zu messen.

6. Gerät nach Anspruch 5, **dadurch gekennzeichnet, daß** der Temperatursensor (14) mit der flexiblen Wand (13) verbunden ist, so daß er der flexiblen Wand (13) während ihrer Verformung folgt, wenn die Wand mit der Bandscheibe (5) in Kontakt gebracht wird.

7. Gerät nach einem Anspruch 1 bis 6, **dadurch gekennzeichnet, daß** ein Rohr (18) mit einem damit verbundenen inneren Teil mittels der optischen Navigationsvorrichtung (20) in Richtung der Bandscheibe (5) dorsolateral einführbar und navigierbar ist, und daß der innere Teil dann durch den therapeutischen Ultraschalltransducer (2) ersetzt wird.

8. Gerät nach einem Anspruch 1 bis 7, **dadurch gekennzeichnet, daß** die diagnostische Kamera (21) eine Röntgenkamera (25) ist.

9. Gerät nach Anspruch 8, **dadurch gekennzeichnet, daß** die Röntgenkamera (25) eine Kalibriervorrichtung (26) mit Markern (27) umfaßt, die angepaßt sind, um die Position der anatomischen Struktur (23), die auf einem Monitor (24) angezeigt wird und an der Bandscheibe (5) des Patienten (4) vorliegt, zu bestimmen.

10. Gerät nach Anspruch 9, **dadurch gekennzeichnet, daß** der Monitor (24) bereitgestellt wird, um zwei Röntgenbilder der anatomischen Struktur (23) zu zeigen, die mit der Röntgenkamera (25) von zwei unterschiedlichen Stellen aufgenommen wurden.

11. Gerät nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, daß** die diagnostische Kamera (21) ein Computertomographiescanner (CT) ist, der bereitgestellt wird, um Bilder der anatomischen Struktur (23) an der Bandscheibe (5) des Patienten (4) zu erzeugen, wobei die Bilder in einem Computerprogramm (Software) zur Erhaltung eines 3D-Bildes auf einem Monitor (24) bearbeitet werden.

12. Gerät nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, daß** die Signalempfangs- oder Signalsendeeinheit (32) bereitgestellt wird, um Signale in Form von Infrarotlicht zu empfangen oder zu senden, und daß die Positionstransmitter (7, 31) bereitgestellt werden, um Signale in Form von Infrarotlicht zu senden oder zu empfangen.

13. Gerät nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, daß** die Temperatur in dem Temperaturfokus (F) des therapeutischen Ultraschalltransducers (2) 45 °C übersteigt.

14. Gerät nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, daß** eine Kalibriervorrichtung (26) zum Kalibrieren des Effektes, der von dem therapeutischen Ultraschalltransducer (2) in dem Temperaturfokus (F) des therapeutischen Ultraschalltransducers (2) ausgestrahlt wird, und/oder der Position des Temperaturfokus (F) in bezug auf das Ultraschallübertragungselement (9) des therapeutischen Ultraschalltransducers (2) bereitgestellt wird.

15. Gerät nach einem der Ansprüche 2 bis 14, **dadurch gekennzeichnet, daß** die Referenzvorrichtung (28) an einem Wirbel (29) in der Wirbelsäule des Patienten, vorzugsweise an dem Spinalfortsatz (30) des Wirbels (29) angebracht wird.

16. Gerät nach einem der Ansprüche 2 bis 15, **dadurch gekennzeichnet, daß** die Referenzvorrichtung (28) Positionstransmitter (31) umfaßt, die aus Metallkugeln, vorzugsweise Tantalkugeln bestehen.

17. Gerät nach Anspruch 16, **dadurch gekennzeichnet, daß** die Signalempfangs- oder Signalsendeeinheit (32) der optischen Navigationsvorrichtung (20) aus mindestens einer Röntgenvorrichtung be-

steht.

Revendications

1. Dispositif de traitement mini-invasif par ultrasons de la pathologie du disque vertébral, dans lequel au moins un transducteur ultrasonore thérapeutique (2) est fourni pour le traitement du disque vertébral (5) d'un patient (4) en générant par les moyens dudit transducteur ultrasonore thérapeutique (2) un champ ultrasonore (3), dont le foyer thermique (F) se trouve dans le disque vertébral (5) pour chauffer celui-ci, **caractérisé en ce que**

   - un dispositif de navigation optique (20) comprend au moins une caméra de diagnostic (21) qui est adaptée pour produire au moins une photographie ou une image de la structure anatomique (23) de la zone de traitement (22) à l'intérieur de laquelle se trouve le disque vertébral (5) à traiter,
   - le transducteur ultrasonore thérapeutique (2) est prévu pour être inséré à travers la peau du patient (4) et engager le disque vertébral (5),
   - le transducteur ultrasonore thérapeutique (2) à son extrémité distale (10) a une paroi flexible (13) ayant la capacité de s'adapter à la surface de l'anneau fibreux (8) ;
   - au moins une chambre de refroidissement (11) pour liquide de refroidissement (12) est prévue à l'extrémité distale (10),
   - au moins un élément de transmission des ultrasons (9) est prévu à l'intérieur de la chambre de refroidissement (11), la chambre de refroidissement (11) se trouvant entre l'élément de transmission (9) et la paroi flexible (13),
   - la chambre de refroidissement (11) avec un liquide de refroidissement (12) est configurée de manière à refroidir l'élément de transmission des ultrasons (9) et le tissu le plus proche du transducteur ultrasonore (2), et
   - au moins un capteur thermique (14) est fourni pour mesurer la température dans le disque vertébral (5).

2. Dispositif selon la revendication 1, **caractérisé en ce que**

   - le dispositif de navigation optique (20) comprend en outre au moins une unité de réception de signaux ou d'envoi de signaux (32) qui est adaptée pour envoyer des signaux aux et/ou recevoir des signaux réfléchis ou autres signaux des transmetteurs de position (31, 7) sur

     a) un dispositif de référence (28) qui a une position définie par rapport au disque vertébral (5), et
     b) le transducteur ultrasonore thérapeutique (2) de telle sorte que la position de celui-ci par rapport à ladite zone de traitement (22) peut être déterminée.

3. Dispositif selon la revendication 2, **caractérisé en ce que** le liquide de refroidissement (12) circule dans la chambre de refroidissement (11).

4. Dispositif selon la revendication 3, **caractérisé en ce que** le liquide de refroidissement (12) est de l'eau.

5. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le capteur thermique (14) est fourni pour mesurer la température du côté intérieur de la paroi flexible (13).

6. Dispositif selon la revendication 5, **caractérisé en ce que** le capteur thermique (14) est connecté à la paroi flexible (13) de telle sorte qu'il suit ladite paroi flexible (13) durant la déformation de celle-ci lorsque ladite paroi est mise en contact avec le disque vertébral (5).

7. Dispositif selon l'une quelconque des revendications 1 à 6, **caractérisé en ce qu'**un tube (18) ayant une partie interne associée peut être inséré de manière dorsolatérale en direction du disque vertébral (5) et peut être déplacé par les moyens du dispositif de navigation optique (20) et **en ce que** ladite partie interne est alors remplacée par le transducteur ultrasonore thérapeutique (2).

8. Dispositif selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** la caméra de diagnostic (21) est une caméra à rayons X (25).

9. Dispositif selon la revendication 8, **caractérisé en ce que** la caméra à rayons X (25) comprend un dispositif d'étalonnage (26) avec des marqueurs (27) qui sont adaptés pour déterminer la position de la structure anatomique (23) affichée sur un moniteur (24) et présente au niveau du disque vertébral (5) du patient (4).

10. Dispositif selon la revendication 9, **caractérisé en ce que** le moniteur (24) est prévu pour afficher deux photographies aux rayons X de ladite structure anatomique (23) prises avec la caméra à rayons X (25) depuis deux emplacements différents.

11. Dispositif selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** la caméra de diagnostic (21) est un tomodensitomètre informatisé (CT) qui est prévu pour produire des images de la structure anatomique (23) au niveau du disque

vertébral (5) du patient (4), lesdites images étant traitées par un logiciel informatique pour obtenir une image en 3D sur un moniteur (24).

12. Dispositif selon l'une quelconque des revendications 1 à 11, **caractérisé en ce que** l'unité de réception de signaux ou d'envoi de signaux (32) est prévue pour recevoir ou envoyer des signaux sous la forme de lumière infrarouge et **en ce que** lesdits transmetteurs de position (7, 31) sont prévus pour envoyer ou recevoir des signaux sous la forme de lumière infrarouge.

13. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la température dans le foyer thermique (F) du transducteur ultrasonore thérapeutique (2) dépasse 45°C.

14. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un dispositif d'étalonnage (26) est prévu pour étalonner l'effet émis par le transducteur ultrasonore thérapeutique (2) dans le foyer thermique (F) dudit transducteur ultrasonore thérapeutique (2) et/ou la position dudit foyer thermique (F) par rapport à l'élément de transmission des ultrasons (9) du transducteur ultrasonore thérapeutique (2).

15. Dispositif selon l'une quelconque des revendications 2 à 14, **caractérisé en ce que** le dispositif de référence (28) est fixé à une vertèbre (29) dans la colonne vertébrale du patient, de préférence à l'apophyse épineuse (30) de ladite vertèbre (29).

16. Dispositif selon l'une quelconque des revendications 2 à 15, **caractérisé en ce que** le dispositif de référence (28) comprend des transmetteurs de position (31) constitués par des billes métalliques, de préférence des billes de tantale.

17. Dispositif selon la revendication 16, **caractérisé en ce que** l'unité de réception de signaux ou d'envoi de signaux (32) du dispositif de navigation optique (20) est constituée par au moins un dispositif à rayons X.

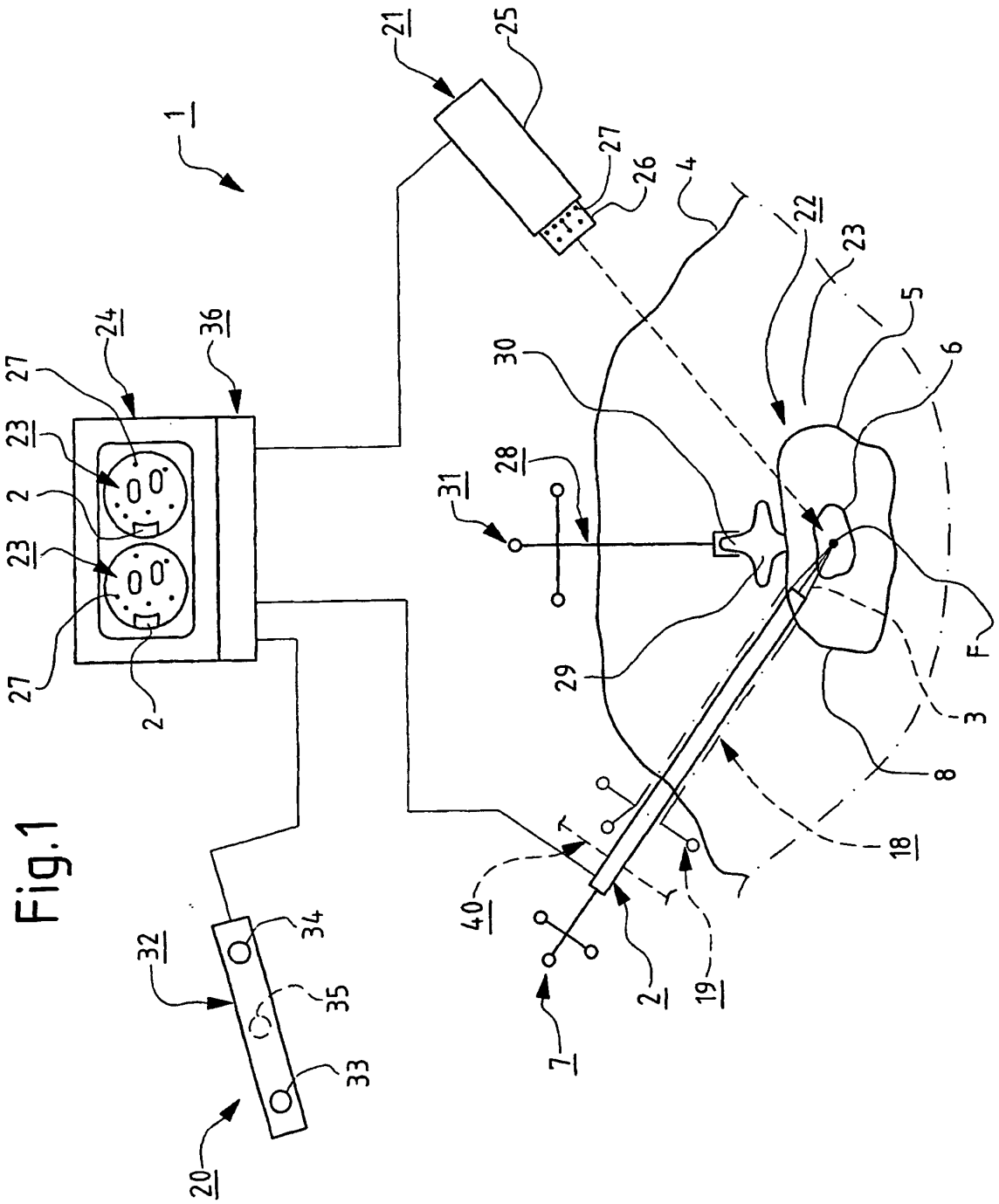
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Fig.1

Fig.2

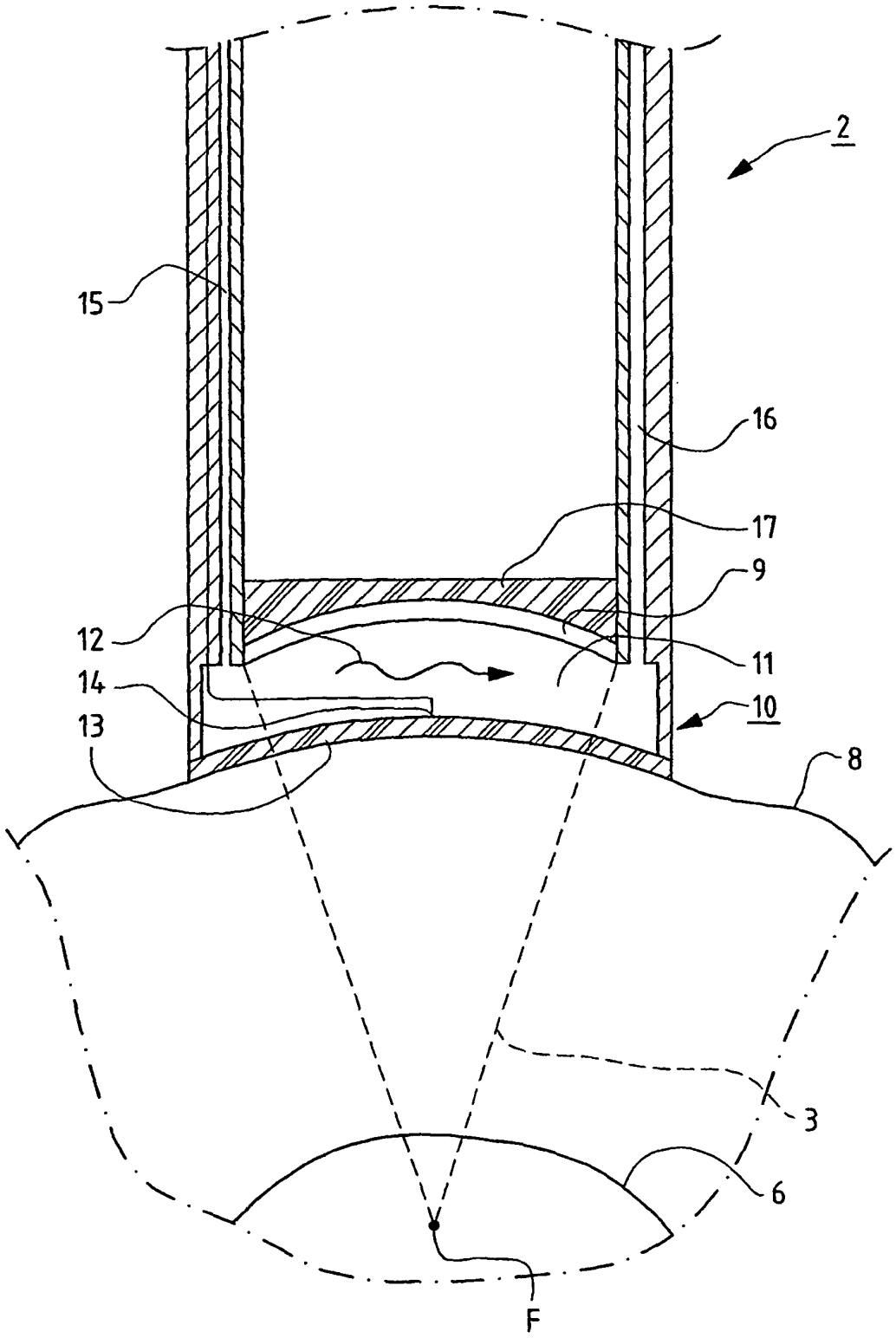
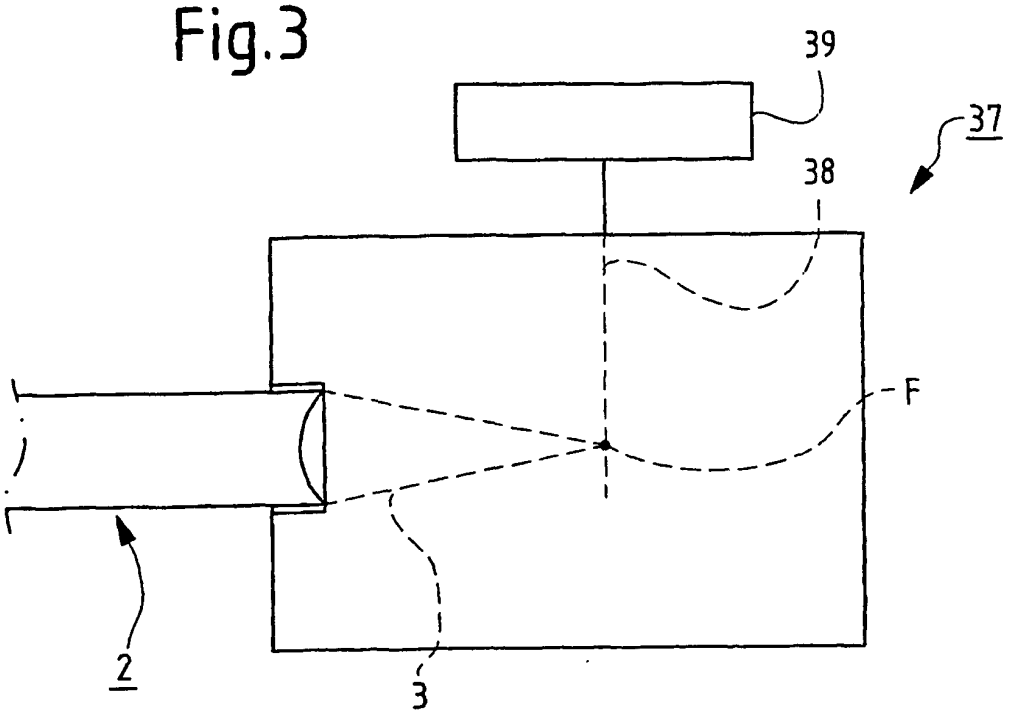


Fig.3



专利名称(译)	用于椎间盘疾病的微创超声治疗的装置		
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申请号	EP2001950183	申请日	2001-07-16
[标]申请(专利权)人(译)	乌尔特拉佐尼克斯DNT股份公司		
申请(专利权)人(译)	ULTRAZONIX DNT AB		
当前申请(专利权)人(译)	ULTRAZONIX DNT AB		
[标]发明人	LIDGREN LARS AKE ALVAR		
发明人	LIDGREN, LARS, AKE, ALVAR		
IPC分类号	A61B17/56 A61B6/00 A61B6/03 A61B6/12 A61B8/00 A61B17/00 A61B18/00 A61B19/00 A61F7/00 A61N7/02		
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摘要(译)

微创超声治疗椎间盘疾病的装置。提供了一种治疗超声波换能器（2），用于通过产生温度聚焦（F）位于盘（5）中的超声场（3）来治疗患者（4）的盘（5）用于加热。该设备包括具有信号接收或信号发送单元（32）的光导航设备（20）。参考装置（28）具有相对于盘（5）的设定位置。治疗性超声换能器（2）被设置用于插入通过患者（4）的皮肤和椎间盘（5），优选为纤维环（8）的接合，并且其具有柔性壁，超声传输元件设置在柔性墙。在柔性壁和超声传输元件之间设置有至少一个冷却室（11），冷却室（11）具有用于冷却超声发射元件和最靠近治疗超声换能器（2）的组织的冷却液体，并且提供温度传感器以测量盘（5），优选纤维环（8）中的温度。