PATENT ASSIGNMENT

Electronic Version v1.1
Stylesheet Version v1.1

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	NUNC PRO TUNC ASSIGNMENT
EFFECTIVE DATE:	09/15/2006

CONVEYING PARTY DATA

Name	Execution Date
Walter A. Roberts	12/09/2011
Brooke Schumm III	11/22/2011

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PROPERTY NUMBERS Total: 2

Property Type	Number
Application Number:	12532123
PCT Number:	US0877100

OP $80.00 12532123

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ATTORNEY DOCKET NUMBER:	ROB-09-005

NAME OF SUBMITTER:	Brooke Schumm III

Total Attachments: 11
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ASSIGNMENT AGREEMENT

THIS AGREEMENT, made and entered into effective this 15th day of September , 2006, between Brooke Schumm III ("Schumm"), and Dr. Walter A. Roberts, M.D. ("Roberts"),

A. Roberts is the inventor, with Schumm as co-inventor on certain claims, of a certain invention called Direct Visualization Robotic Intra-Operative Radiation Therapy Applicator Device, on which a number of provisional applications, international application and a U.S. Patent Application have been filed with among other numbers, Serial Nos. PCT/US2008/77100 and 12/532,123 ("Invention") and other application numbers listed on Exhibit A. Claims in the Invention have been allowed.

B. Brooke Schumm III, an attorney retained by Roberts, has made certain contributions reflected in the claims to said Invention as to which he is a joint inventor. Schumm has been paid for his counsel fees and agreed as Roberts' agent and counsel, and as the agent and counsel for Roberts to assign any invention to Roberts and his or their designee. Roberts and Schumm utilized Schumm's services to form SRIORT, LLC also known as SRT, LLC, a Maryland limited liability company (referred to for convenience sake as "SRT" or "Assignee").

C. Schumm signed an agreement on behalf of SRT with the University of Delaware in June, 2009 for students to work on a project to make the invention referenced in the Invention description as part of their Senior Mechanical Engineering Design course. Thomas Cender ("Cender"), and Mason Gibbs ("Gibbs") were on the project team. Schumm and Roberts worked with Cender and Gibbs and, starting after September, 2009, they suggested certain improvements and changes in the capsule for the Invention to which Schumm and Roberts responded and which Schumm and Roberts modified, culminating in a final design and build of a model capsule approximately two times the size of the intended actual by Cender and Gibbs and their teammates.

D. By the attached assignment, Cender and Gibbs assigned their rights to Roberts and Schumm or their designee, which Roberts and Schumm have elected to be SRIORT, LLC.

NOW THEREFORE, in consideration of the mutual covenants, promises and obligations in this Agreement, and $10.00 paid in hand and other good and valuable consideration, the parties agree as follows:

1. Roberts and Schumm hereby assign to Assignee, all of their entire right, title and interest in the entire Invention, including any improvements, patent rights, and applications, including divisions, continuations, and continuations-in-part, reissues, and extensions thereof and all rights of priority resulting from the filing of the U.S. application(s), both domestic and foreign.

2. Roberts, and Schumm mutually agree and request any official whose duty it is to issue patents to issue any patent on said Invention, and any improvements on or resulting therefrom to Assignee, its successors, assigns or nominees, and assign all rights pursuant to the attached assignment to Assignee. Roberts and Schumm agree, that on request and without further consideration, but at the expense of Assignee, expense for preparation of any and all papers or applications or other documents and for any other costs, they will communicate any facts known to them respecting said improvement, sign all lawful papers prepared by Assignee, execute all divisional, continuing, and reissue applications, and make all rightful oaths to aid the assignee and its successors, assigns and nominees to obtain and enforce proper patent protection for said Invention and the inventor's contributions in any country.

Walter A. Roberts, M.D.

Brooke Schumm III Co-inventor and counsel

SRIORT, LLC a/k/a SRT, LLC

Brooke Schumm III
Its authorized agent

Exhibit A to Assignment

U.S. Serial No. 12/532,123

PCT/US2008/77100

U.S. Serial No. 12/886,493

U.S. Provisional Appl. 61/098,225

U.S. Provisional Appl. 60/973,545

U.S. Provisional Appl. 61/377,252

ASSIGNMENT AGREEMENT

THIS AGREEMENT, made and entered into effective this 1st day of September , 2009, between Thomas Cender ("Cender"), Brooke Schumm III ("Schumm"), Dr. Walter A. Roberts, M.D. ("Roberts"), and SRIORT, LLC also known as SRT, LLC, a Maryland limited liability company ("SRT"),

A. Roberts is the inventor, with Schumm as co-inventor on certain claims, of a certain invention called Direct Visualization Robotic Intra-Operative Radiation Therapy Applicator Device, on which a number of provisional applications, international application and a U.S. Patent Application have been filed with among other numbers, Serial Nos. PCT/US2008/77100 and 12/532,123 ("Invention").

B. Brooke Schumm III, an attorney retained by Roberts, has made certain contributions reflected in the claims to said Invention as to which he is a joint inventor. Schumm has been paid for his counsel fees and agreed as Roberts' agent and counsel, and as the agent and counsel for Roberts and SRT to assign any invention to Roberts and his or their designee.

C. Schumm signed an agreement on behalf of SRT with the University of Delaware in June, 2009 for students to work on a project to make the invention referenced in the Invention description as part of their Senior Mechanical Engineering Design course. Cender and Mason Gibbs were on the project team. Schumm and Roberts worked with Cender and Mason Gibbs ("Gibbs") and, starting after September, 2009, they suggested certain improvements and changes in the capsule for the Invention to which Schumm and Roberts responded and which Schumm and Roberts modified, culminating in a final design and build of a model capsule approximately two times the size of the intended actual by Cender and Gibbs and their teammates.

NOW THEREFORE, in consideration of the mutual covenants, promises and obligations in this Agreement, and $10.00 paid in hand and other good and valuable consideration, the parties agree as follows:

1. Cender hereby assigns to Roberts and Schumm, or their designee (Assignee") in a separate writing, all of their entire right, title and interest in the entire Invention, including any improvements, patent rights, and applications, including divisions, continuations, and continuations-in-part, reissues, and extensions thereof and all rights of priority resulting from the filing of the U.S. application(s), both domestic and foreign.

2. Cender, Roberts, and Schumm mutually agree and request any official whose duty it is to issue patents to issue any patent on said Invention, and any improvements on or resulting therefrom to Assignee, its successors, assigns or nominees. Cender agrees, that on request and without further consideration, but at the expense of Roberts and Schumm, expense for preparation of any and all papers or applications or other documents and for any other costs, they will communicate any facts known to them respecting said improvement, sign all lawful papers

prepared by Roberts, Schumm or Assignee, execute all divisional, continuing, and reissue applications, and make all rightful oaths to aid the assignee and its successors, assigns and nominees to obtain and enforce proper patent protection for said Invention and the inventor's contributions in any country.

Thomas Cender

Walter A. Roberts, M.D.

Brooke Schumm III Co-inventor and counsel

SRIORT, LLC a/k/a SRT, LLC

Brooke Schumm III
Its authorized agent

ASSIGNMENT AGREEMENT

THIS AGREEMENT, made and entered into effective this 1st day of September , 2009, between Mason J. Gibbs ("Gibbs"), Brooke Schumm III ("Schumm"), Dr. Walter A. Roberts, M.D. ("Roberts"), and SRIORT, LLC also known as SRT, LLC, a Maryland limited liability company ("SRT"),

A. Roberts is the inventor, with Schumm as co-inventor on certain claims, of a certain invention called Direct Visualization Robotic Intra-Operative Radiation Therapy Applicator Device, on which a number of provisional applications, international application and a U.S. Patent Application have been filed with among other numbers, Serial Nos. PCT/US2008/77100 and 12/532,123 ("Invention").

B. Brooke Schumm III, an attorney retained by Roberts, has made certain contributions reflected in the claims to said Invention as to which he is a joint inventor. Schumm has been paid for his counsel fees and agreed as Roberts' agent and counsel, and as the agent and counsel for Roberts and SRT to assign any invention to Roberts and his or their designee.

C. Schumm signed an agreement on behalf of SRT with the University of Delaware in June, 2009 for students to work on a project to make the invention referenced in the Invention description as part of their Senior Mechanical Engineering Design course. Thomas Cender and Mason J. Gibbs were on the project team. Schumm and Roberts worked with Cender and Mason Gibbs ("Gibbs") and, starting after September, 2009, they suggested certain improvements and changes in the capsule for the Invention to which Schumm and Roberts responded and which Schumm and Roberts modified, culminating in a final design and build of a model capsule approximately two times the size of the intended actual by Cender and Gibbs and their teammates.

NOW THEREFORE, in consideration of the mutual covenants, promises and obligations in this Agreement, and $10.00 paid in hand and other good and valuable consideration, the parties agree as follows:

1. Gibbs hereby assigns to Roberts and Schumm, or their designee (Assignee") in a separate writing, all of their entire right, title and interest in the entire Invention, including any improvements, patent rights, and applications, including divisions, continuations, and continuations-in-part, reissues, and extensions thereof and all rights of priority resulting from the filing of the U.S. application(s), both domestic and foreign.

2. Gibbs, Roberts, and Schumm mutually agree and request any official whose duty it is to issue patents to issue any patent on said Invention, and any improvements on or resulting therefrom to Assignee, its successors, assigns or nominees. Gibbs agrees, that on request and without further consideration, but at the expense of Roberts and Schumm, expense for preparation of any and all papers or applications or other documents and for any other costs, they

will communicate any facts known to them respecting said improvement, sign all lawful papers prepared by Roberts, Schumm or Assignee, execute all divisional, continuing, and reissue applications, and make all rightful oaths to aid the assignee and its successors, assigns and nominees to obtain and enforce proper patent protection for said Invention and the inventor's contributions in any country.

Mason J. Gibbs

Walter A. Roberts, M.D.

Brooke Schumm III Co-inventor and counsel

SRIORT, LLC a/k/a SRT, LLC

Brooke Schumm III
Its authorized agent

SUMMARY OF THE INVENTION

The invention contemplates a radiation oblation capsule mounted onto an arm of a da Vinci® surgical robot machine. The preferred mode is for an Iridium-192 radioactive isotope that will emit gamma and beta rays to eliminate cancerous tissue. The capsule would enable the radiation oncologist and surgeon, upon completion of surgery, to immediately, while the patient is under anesthesia, oblate (bombard with radiation) cancer sites internal to the patient, view them visually in real time and examine the tissue and determine if any further oblation is needed.

Currently, intra-operative radiation therapy has been delivered via large, cumbersome linear accelerators. These have been shown to substantially improve outcomes, but have harsh side effects. For oblation of internal tissue by a linear accelerator, a patient has to be surgically open and due to the large size and heavy shielding requirements, the procedure is infrequently used or not available. The ROC would permit frequent use and would implement an already existing machine, the da Vinci Surgical System® produced by Intuitive Surgical, Inc. Side effects are significantly reduced because the capsule delivers precise radiation to tumor sites, while the dose to normal tissue is minimized.

The invention is contemplated to be inserted into a 1-3 centimeter incision the doctor will make in the patient. The invention preferably uses a combination of doors. The first is an aperture disk which has a conical hole. The aperture disk rotates; when the conical hole is aligned with the isotope opening, radiation will be emitted. As the conical opening is rotated and no longer aligned, the aperture is in the OFF position and no radiation is emitted. The second door is a sliding door that slides up and down a portion of the length of the capsule. This door also has a fail safe mechanism which can be a spring. In the event of power failure, the spring will force the door closed to prevent any unwanted radiation exposure.

The capsule can be set up while the radioisotope is in a lead pig on a table, and the capsule moved by the surgical robot to pick up a cartridge containing the radioisotope. Alternatively, the robot can pick up the capsule in which the radioisotope is permanently mounted, with the capsule store in the pig.

Intra-operative radiation therapy contemplated in this invention is used primarily to treat tumors that cannot be completely removed surgically because of their close proximity to vital, healthy tissue. After physically removing as much of the tumor as possible, at present, a linear accelerator is used to deliver a concentrated dosage of radiation directly onto the exposed cancerous tissue. An example of such a linear accelerator is the IntraOp Mobetron ® , which is the current device for this type of radiation therapy. The machine's bulky size makes delivering the radiation dosage difficult without harming other healthy tissues. This difficulty is particularly problematic in the treatment of abdominal cancers where tumors are often on or near vital organs. The surgeon is not able to manipulate the beam of radiation sufficiently to avoid collateral damage of other healthy tissues in the abdominal cavity.

Using the present invention, a small capsule manipulated by a robotic arm inside the patient would eliminate the collateral damage to healthy tissue that is associated with these procedures.

The da Vinci Surgical System® is the robotic surgical device that is to be used to manipulate, control, and direct the radiation capsule while it is inside the body cavity of a human. Asurgeon seated at a control station manipulates hand controls with several degrees of freedom. These hand controls translate the surgeons hand motions into end-effector movement. Different end effectors are used for different purposes (i.e. gripping and grabbing tissue, others for cutting, sawing, sewing, or any other action that is conventionally performed by the hand of a surgeon). These end effectors of the da Vinci® arms actually have a wider range of motion than the human wrist.

This invention mounted on to the da Vinci® arms would be capable of attacking tumors from a variety of angles that simply could never be achieved using standard linear accelerator technology.

Additionally, in the present invention, the camera mounted in the capsule provides direct visualization to the surgeon at the operating station so that he can see, in real time, what he is operating on, locating and attacking multiple tumor sites in one operation. The surgeon can, therefore, more effectively destroy cancerous tissue in the body while dramatically reducing collateral damage to healthy, vital tissue. This capability is far superior to standard treatment methods today.

OBJECTIVES OF THE INVENTION

Safety: Capsule adequately shields both patient and surgeon from unwanted radiation exposure

Geometry: A smooth capsule surface prevents the capsule from snagging on any tissue it comes in contact with

Size: Capsule must be small enough to be mobile within a human body cavity

Precision Alignment: Aperture must align accurately with radiation source for successful exposure

Reliability: Doors must fully open and close for every cycle

Radiation Exposure: Radiation must produce a circular pattern of a known diameter through a conical hole

PREFERRED MODE OF INVENTION

A preferred way to implement the invention is to build a capsule so it can be assembled together. The capsule (1) has various parts. Starting with a slide door (2) which can be alternately opened and closed to occlude radiation, that door slides into a front mount (3) which has a front mount opening (21) . The slide door covers an aperture disk (4) which has one or more conical apertures (5) with central cone axis for each aperture. The slide door is shaped similarly to a trapezoid and sits in a trapezoidal channel (21) in the front mount and slides in a trapezoidal channel (22) in the end cap. The slide door includes a toothed rack (20) that will be connected to it. The rack of the sliding door is mated with a pinion and is driven by a stepper motor. The motion created by the motor-rack-and-pinion system slides the door up and down opening and closing the capsule.

The aperture disk can be rotated alternately to occlude radiation, and in cooperation with proper material selection for the capsule, can, in a three cm. diameter capsule, occlude radiation emitted from a radiation source (6), an isotope. The isotope is disposed centrally in the capsule and interior to the aperture disk. The aperture disk has the conical openings widening toward the exterior of the capsule and when the slide door is open, the front mount opening is wider than the cone cast by the conical opening in the aperture disk. The front mount fits onto a back mount (7) which together account for about one-half the outside shape of the capsule. The radiation source is secured in a cartridge (8) which fits into the back mount. The front and back mounts are secured to an end cap (9) with the combination forming an oval cylinder which is the shape of the capsule. The end cap has apertures to contain two motors (9) and (10) to operate the aperture disk and the slide door. The motors are disposed so that the central axis of the rotating shaft of each motor is parallel to the long axis of the capsule. A motor mounting plate (11) secures the motor into the end cap. The end cap has a spring guide (12) which guides a spring (13) which exerts force against the slide door to force it closed in the event of a power failure to the capsule. Two bevel gears (14) on the motor shafts drive bevel gears (15) on two shafts (16) mounted into the back mount and when the motor operates, the bevel gears on the motor shafts rotate the bevel gears on the shafts mounted into the back mount. Through one set of bevel gears, one motor drives a spur gear (17) connected to an aperture spear gear (18) fixed on the aperture disk and causes the aperture disk to rotate to a desired position. The other motor, through the other set of bevel gears, drives a pinion gear (19) which drives a toothed rack (20) attached to the slide door which causes the slide door to move to an open or closed position.

For a capsule of three cm. diameter and approximately 6.5 cm. long, for an Iridium192 source, approximately 90% of radiation can be eliminated when the slide door is closed and the aperture disk occludes the radiation source from the slide door.

The stepper motors are controlled from [to be drafted]

This design maintains good radiation shielding from all directions.

Also contemplated are a fiber optic camera, and a light source to illuminate tissue. They can be disposed in a variety of positions adjacent to the front mount opening in the front mount which opening is alternately occluded by the slide door.

Also contemplated is a circuit to operate an indicator light to verify if the slide door is open or closed.

A positioning device such as a range finder or ultrasound device is contemplated.