CHEST OPENING AND SPREADING DEVICE

Field of the Invention

The present invention relates to the technical field of medical apparatuses, and in particular to a chest opening and spreading device.

Background to the Invention

A thoracic retractor is a tool commonly used in general thoracic surgery, which is used to spread ribs to a certain extent to facilitate the establishment of surgical access. The traditional thoracic retractor is relatively simple in structure, similar in appearance to a vernier caliper, and included by fixing arms, movable arms and sliding ways, in which the movable arms and the fixing arms are used to spread the ribs.

With the continuous advancement of medical technology and the improvement of patients' expectation of surgical outcomes, thoracotomy requires more precision. The structure of the chest is complex and involves many important organs and blood vessels. During surgery, it is necessary to precisely control the exposure of the surgical field and the degree of opening of the wound to reduce damage to surrounding tissues and improve the success rate of surgery. Therefore, a precise adjustment and stable support thoracotomy spreading device has become an urgent need in modern thoracic surgery.

During the long-term thoracotomy, medical staff need to operate surgical instruments continuously to maintain a high degree of concentration and stability. Traditional spreading methods may have problems including cumbersome operation, poor stability, which increases the workload and fatigue of medical staff. Therefore, the development of an easy-to-operate and reasonable ergonomic design for thoracotomy spreading device can significantly improve the work efficiency of medical staff and reduce discomfort and fatigue during the operation.

Thoracotomy has caused considerable physical and psychological effects on patients. An excellent thoracotomy spreading device can provide stable support during surgery, and

ensure clear exposure of the surgical field, thereby reducing surgical risks and ensuring patient safety. At the same time, by reducing surgical trauma and complications, it is also helpful to promote the postoperative recovery and rehabilitation effect of patients. Therefore, developing a safe and reliable thoracotomy spreading device is of great significance to improve the patient's surgical experience and post-surgical quality of life.

After searching, the China patent with an application number of 202420760670.2 provides an adjustable thoracic retractor, which includes thoracic retractor guide posts, chest opening guide frames, chest opening brackets and chest opening screw rods. Inner sides of the chest opening guide posts are disposed with screw grooves. Compared with the related art, this invention has the following beneficial effects: by adding the chest opening guide posts, chest opening holders, the chest opening brackets, the chest opening screw rods and auxiliary rods, according to the actual chest opening position and size, the chest opening brackets are pulled to slide left and right to proper positions, the adjusting screw rods are rotated to match with adjustment threaded holes, the pressure plates squeeze the positioning plates to fix the chest opening brackets, the auxiliary rods are rotated to rotate the chest opening screw rods to drive two groups of chest opening guide frames to move to the center and the outside at the same time, and the positions of the chest opening brackets can be adjusted according to the actual chest opening needs. By adding the chest opening screw rods and the auxiliary rods, the auxiliary rods are pulled to the outside to embed the auxiliary rods into the embedding holes, and the locking columns can be embedded into the locking holes when the external force is removed.

When the above-mentioned thoracic retractor needs to adjust the distance between the chest opening brackets, the auxiliary rod needs to be manually shaken to drive the chest opening screw rods to rotate, thereby adjusting the distance between the chest opening brackets, and the manual operation process has the problems of laborious and unstable adjustment.

Statement of Invention

For the above-mentioned thoracic retractor in the related art, a distance between chest

opening brackets needs to be adjusted manually or electrically, which further has technical problems of laborious operation and unstable adjustment.

Technical ideas: in view of the problems in the related art, the present invention provides a chest opening and spreading device. By manually and repeatedly lifting a pressing handle, the pressure in a hydraulic inner cylinder can further drive a hydraulic column to rise, and the hydraulic column can push a movable rod to drive a chest opening bracket to move, thereby achieving the technical effect of spreading and fixing the patient's ribs by spreading plates.

In order to realize the above technical ideas, the present invention provides the following technical solutions.

The present application provides a chest opening and spreading device, including a base and two spreading plates arranged above the base, further including a spreading assembly slidably arranged in the base for adjusting a spreading distance of the two spreading plates, and a hydraulic adjustment assembly connected to the base for controlling the spreading assembly.

Further, the spreading assembly includes fixing blocks, springs A, movable rods, chest opening brackets and spreading frames; and

the fixing blocks are fixedly connected to inner walls on two sides of the base, and a movable groove is disposed in each of the fixing blocks; the spring A is arranged in each of the movable grooves, and ends of the springs A are connected to the movable rods; ends of the movable rods are fixedly connected to the springs A, the other ends abut against the hydraulic adjustment assembly, and the movable rods are slidably connected to the fixing blocks and the chest opening brackets; and each of the chest opening brackets is connected to the spreading frame, and the spreading frames are connected to the spreading plates through bolts.

Specifically, the movable rod includes two parts, one part is a cylindrical structure and the other part is a wedge-shaped block structure; the chest opening bracket includes three parts: two L-shaped brackets, a cube and a cuboid. The cylindrical part of the movable rod is slidably connected to the cube part of the chest opening bracket, and the wedge block

part of the movable rod is clamped with the cube part of the chest opening bracket.

Furthermore, the hydraulic adjustment assembly includes a hydraulic outer cylinder, a hydraulic inner cylinder, a hydraulic column, a connecting block, a piston cylinder, a piston rod, a handle and a bracket; and

a bottom of the base is connected to the hydraulic outer cylinder, the hydraulic outer cylinder is sleeved with the hydraulic inner cylinder, and an interval exists between the hydraulic outer cylinder and the hydraulic inner cylinder; the hydraulic column is arranged in the hydraulic inner cylinder, and two sides of the hydraulic column abut and cooperate with the movable rods; bottoms of the hydraulic outer cylinder and the hydraulic inner cylinder are connected to the connecting block, and the connecting block is internally arranged with a liquid inlet channel and a liquid outlet channel; an end of the connecting block is connected to the piston cylinder and the bracket, the piston rod is arranged in the piston cylinder, the handle is rotatably connected to the piston rod, and the handle is rotatably connected to the bracket; and ends of the liquid outlet channel and the liquid inlet channel are communicated with the piston cylinder, and the other ends are communicated with the hydraulic outer cylinder and the hydraulic inner cylinder, and liquid stopping components are arranged in the liquid outlet channel and the liquid inlet channel.

It is to be noted that the hydraulic outer cylinder is filled with hydraulic oil.

In the above technical solution, one of the liquid stopping component includes a liquid stopping groove, a liquid stopping ball and a spring B arranged in the liquid stopping groove, one end of the spring B is fixedly connected in the liquid stopping groove, and the other end is fixedly connected to the liquid stopping ball.

Preferably, the chest opening brackets are arranged with electric adjustment assemblies, and the electric adjustment assemblies are used to adjust front and rear positions of the spreading plates.

Specifically, the electric adjustment assemblies include motors, screw rods and sliding blocks; and

a sliding groove is disposed on each of the chest opening brackets, the screw rods are

arranged in the sliding grooves, ends of the screw rods are rotatably connected to the chest opening brackets, and the other ends are connected to the motors; and the screw rods are fitted with the sliding blocks in a threaded way, two sides of the sliding blocks are slidably clamped in the sliding grooves, and tops of the sliding blocks are fixedly connected to the spreading frames.

Specifically, two sides of the base are connected to clamping plates for clamping an operating bed through screws.

More specifically, cavity is disposed in the base, two through grooves matched with the chest opening brackets are disposed on front and rear sides of the base, and sliding rails matched with the chest opening brackets are disposed at the bottom of the base.

Preferably, ends of the spreading frames are disposed with a plurality of threaded holes matched with the bolts on the spreading plates, and the spreading plates are arranged with silicone pads.

Compared with the related art, the present invention has the following advantageous effects.

1. In the present invention, the pressure in the piston cylinder is changed by repeatedly pressing the handle manually, the hydraulic oil in the hydraulic outer cylinder enters the hydraulic inner cylinder, and the hydraulic oil pushes the hydraulic column to move upward along the hydraulic inner cylinder. During the upward movement of the hydraulic column, the movable rods on two sides are pushed to move outward, and the springs A connected to the movable rods have the technical effect of buffering, the movable rods move more stably, and the movable rods drive the chest opening brackets to move, thereby achieving the technical effect of the spreading plate supporting and fixing the ribs on two sides of the patient.

2. The adjustment of the spreading distance of the spreading plates is achieved through hydraulic principles. Compared with manual adjustment, the hydraulic adjustment assembly is labor-saving and more stable than electric adjustment.

3. In the present invention, the sliding grooves are disposed on the chest opening brackets,

the motors arranged on the chest opening brackets drive the screw rods to rotate, and the sliding blocks drive the spreading plates to move forward and backward through the thread fit between the screw rods and the sliding blocks, thereby achieving the technical effect of flexibly adjusting the forward and backward positions of the spreading plates according to the position of the chest opening.

4. In the present invention, the plurality of threaded holes disposed on the spreading frames cooperate with the bolts on the spreading plates, the distance between the two spreading plates can be further adjusted, and the distance between the spreading plates can be adjusted to the most appropriate degree during the surgical operation, thereby improving the adjustment accuracy, and improving the success rate of the surgical operation and the comfort of the patient.

5. In the present invention, the silicone pads are arranged on the two spreading plates, and the spreading plates have a certain cushioning property when contacting the ribs of the patient's chest, thereby preventing the patient's ribs and other tissues from being damaged and causing complications, and helping patients to recover after surgery.

Brief Description of the Drawings

To describe the technical solutions in the examples of the present invention more clearly, the following is a brief introduction to the accompanying drawings required in the examples. It is to be understood that the following accompanying drawings only show some examples of the present invention and are not to be regarded as limiting the scope. For those ordinary skilled in the art, other relevant accompanying drawings can also be obtained based on these accompanying drawings without exerting creative efforts.

FIG. 1 is a perspective view of an overall structure of the present invention;

FIG. 2 is a top view of FIG. 1 of the present invention;

FIG. 3 is a bottom view of FIG. 2 of the present invention;

FIG. 4 is a cross-sectional view along an A-A direction in FIG. 3 of the present invention;

FIG. 5 is a front view of FIG. 1 of the present invention;

FIG. 6 is a cross-sectional view along a B-B direction in FIG. 5 of the present invention;

FIG. 7 is a right view of FIG. 5 of the present invention;

FIG. 8 is an enlarged view of part A in FIG. 4 of the present invention; and

FIG. 9 is a perspective structural view of chest opening brackets of the present.

Reference numerals and denotations thereof: 1-base; 2-spreading plate; 3-spreading assembly; 31-fixing block; 32-spring A; 33-movable rod; 34-chest opening bracket; 35-spreading frame; 4-hydraulic adjustment assembly; 41-hydraulic outer cylinder; 42-hydraulic inner cylinder; 43-hydraulic column; 44-connecting block; 441-liquid inlet channel; 442-liquid outlet channel; 45-piston cylinder; 46-piston rod; 47-handle; 48-bracket; 5-liquid stopping component; 51-liquid stopping groove; 52-liquid stopping ball; 53-spring B; 6-electric adjustment assembly; 61-motor; 62-screw rod; 63-sliding block; 7-clamping plate; 8-threaded hole; and 9-silicone pad.

Detailed Description

To enable those of ordinary skilled in the art to better understand the technical solutions of the present invention, the technical solutions of the present invention will be further described below with reference to the accompanying drawings and examples.

In the description of the present disclosure, it is to be understood that the terms "upper", "lower", "front", "rear", "left", "right", "front end", "rear end", "inner side", "outer side", and the like indicate orientations or positional relationships based on the orientation or positional relationships shown in the figures, are merely for convenience in describing the present invention and to simplify the description, and do not indicate or imply that the referenced devices or elements must have a particular orientation, be constructed and operated in a particular orientation, and thus are not to be construed as limiting the present invention.

In the description of this invention, it is to be noted that, unless expressly specified and limited otherwise, the terms "arranged", "mounted", "connected", and "linked" are to be understood broadly. For example, a connection can be a fixed connection, a detachable

connection, and an integral connection; and a direct connection, an indirect connection through an intermediate medium, or internal communication between two elements. For those of ordinary skilled in the art, the specific meanings of the above terms in this invention can be understood according to specific circumstances.

The inventor has found that existing sternal retractors cannot be stably fixed to the sternum during use and are prone to fall off or shift, which may affect the accuracy and safety of surgery. The sternal retractors require direct contact with the patient's sternum, which may cause discomfort or injury to the patient, such as pressure, pain, etc.

Based on the above findings, the present invention provides a chest opening and spreading device, which includes a base 1 and two spreading plates 2 arranged above the base 1, and further includes a spreading assembly 3 slidably arranged in the base 1 and used to adjust a spreading distance between the two spreading plates 2, and a hydraulic adjustment assembly 4 connected to the base 1 and used to control the spreading assembly 3.

Example 1

Referring to FIGS. 1-9, the present invention provides a chest opening and spreading device, which includes a base 1 and two spreading plates 2 arranged above the base 1, and further includes a spreading assembly 3 slidably arranged in the base 1 for adjusting a spreading distance between the two spreading plates 2, and a hydraulic adjustment assembly 4 connected to the base 1 for controlling the spreading assembly 3.

Further, the spreading assembly 3 includes fixing blocks 31, springs A 32, movable rods 33, chest opening brackets 34 and spreading frames 35;

the fixing blocks 31 are fixedly connected to inner walls on two sides of the base 1, and a movable groove is disposed in each of the fixing blocks 31;

the spring A 32 is arranged in each of the movable grooves, and ends of the springs A 32 are connected to the movable rods 33; and the springs A 32 have the buffering effect on the movement of the movable rods 33, and the spreading plates 2 can move stably;

ends of the movable rods 33 are fixedly connected to the springs A 32, the other ends abut

against the hydraulic adjustment assembly 4, and the movable rods 33 are slidably connected to the fixing blocks 31 and the chest opening brackets 34; and

each of the chest opening brackets 34 is connected to the spreading frame 35, and the spreading frames 35 are connected to the spreading plates 2 through bolts.

A cavity is disposed in the base 1, two through grooves matched with the chest opening brackets 34 are disposed on front and rear sides of the base 1, and sliding rails matched with the chest opening brackets 34 are disposed at the bottom of the base 1.

Furthermore, hydraulic adjustment assembly 4 includes a hydraulic outer cylinder 41, a hydraulic inner cylinder 42, a hydraulic column 43, a connecting block 44, a piston cylinder 45, a piston rod 46, a handle 47 and a bracket 48;

a bottom of the base 1 is connected to the hydraulic outer cylinder 41, the hydraulic outer cylinder 41 is sleeved with the hydraulic inner cylinder 42, and an interval exists between the hydraulic outer cylinder 41 and the hydraulic inner cylinder 42;

the hydraulic column 43 is arranged in the hydraulic inner cylinder 42, and two sides of the hydraulic column 43 abut and cooperate with the movable rods 33;

especially, an upper end of the hydraulic column 43 is a wedge block structure, which cooperates with ends of the movable rods 33;

bottoms of the hydraulic outer cylinder 41 and the hydraulic inner cylinder 42 are connected to the connecting block 44, and the connecting block 44 is internally arranged with a liquid inlet channel 441 and a liquid outlet channel 442;

an end of the connecting block 44 is connected to the piston cylinder 45 and the bracket 48, the piston rod 46 is arranged in the piston cylinder 45, the handle 47 is rotatably connected to the piston rod 46, and the handle 47 is rotatably connected to the bracket 48; and

ends of the liquid outlet channel 442 and the liquid inlet channel 441 are communicated with the piston cylinder 45, and the other ends are communicated with the hydraulic outer cylinder 41 and the hydraulic inner cylinder 42, and liquid stopping components 5 are arranged in the liquid outlet channel 442 and the liquid inlet channel 441.

In the above technical solution, one of the liquid stopping component 5 includes a liquid stopping groove 51, a liquid stopping ball 52 and a spring B 53 arranged in the liquid stopping groove 51, one end of the spring B 53 is fixedly connected in the liquid stopping groove 51, and the other end is fixedly connected to the liquid stopping ball 52.

In an initial state, the piston rod 46 is located at the bottom of the piston cylinder 45, and the bottom of the piston rod 46 blocks the liquid inlet channel 441 and the liquid outlet channel 442. When the handle 47 is manually lifted, the handle 47 drives the piston rod 46 to move upward along the piston cylinder 45, the pressure in the piston cylinder 45 decreases, the liquid stopping balls 52 in the liquid outlet channel 442 move upward, the springs B are compressed, and the hydraulic oil in the hydraulic outer cylinder 41 enters the piston cylinder 45 through the liquid outlet channel 442.

Further, by pressing down the handle 47, the hydraulic oil in the piston cylinder 45 enters the hydraulic inner cylinder 42 through the liquid inlet channel 441. In this way, the handle 47 is repeatedly lifted and pressed down several times, and the hydraulic oil in the hydraulic inner cylinder 42 pushes the hydraulic column 43 to move upward along the hydraulic inner cylinder 42.

As the hydraulic column 43 moves upward, the hydraulic column 43 pushes the movable rods 33 to move to two sides, and the movement of the movable rods 33 drives the chest opening brackets 34 to move, thereby causing the spreading frames 35 to drive the spreading plates 2 to move, and achieving the adjustment of the distance between the two spreading plates 2.

Example 2

Based on the Example 1, in order to adjust front and rear positions of the spreading plates 2, electric adjustment assemblies 6 are arranged on the chest opening brackets 34.

Specifically, the electric adjustment assemblies 6 include motors 61, screw rods 62 and sliding blocks 63; and

Further, a sliding groove is disposed on each of the chest opening brackets 34, the screw rods 62 are arranged in the sliding grooves, ends of the screw rods 62 are rotatably

connected to the chest opening brackets 34, and the other ends are connected to the motors 61; and the screw rods 62 are fitted with the sliding blocks 63 in a threaded way, two sides of the sliding blocks 63 are slidably clamped in the sliding grooves, and tops of the sliding blocks 63 are fixedly connected to the spreading frames 35.

Two sides of the base 1 are connected to clamping plates 7 for clamping an operating bed through screws; and the base 1 can be placed at the bottom of the operating bed, and further clamped with the edge of the operating bed through the clamping plates 7, thereby making the overall device more stable.

Furthermore, ends of the spreading frames 35 are disposed with a plurality of threaded holes 8 matched with the bolts on the spreading plates 2; and the distance between the spreading plates 2 can be further adjusted through the cooperation of the threaded holes 8 and the bolts to achieve precise adjustment during surgery. The spreading plates 2 are arranged with silicone pads 9 to prevent too hard material from damaging the patient's sternum and other tissues.

Specific application cases

Combined with Example 1 and Example 2, Specifically, the specific application of the chest opening and spreading device of the present invention in thoracotomy for congenital heart disease will be specifically described.

Thoracotomy treatment of congenital heart disease requires extracorporeal circulation technology. Generally, the thorax is opened, and the aorta and the superior and inferior vena cava are cannulated to establish extracorporeal circulation. After the extracorporeal circulation is started, the aorta is blocked, the heart is stopped, and the heart is opened to repair cardiac abnormalities. After the operation is completed, the heart is sutured, the aorta is opened, and the heart is restarted. The extracorporeal circulation is gradually withdrawn, and the heart is beating. After the heart recovers to normal, the thorax is closed, and the operation is completed.

During surgery, it is necessary to expose the surgical field to spread the wound, and a spreader is used. In the specific use process of the chest opening and stretching device in the present invention, the base 1 is partially placed at the bottom of the operating bed, and

the screws on two sides of the base 1 are further screwed, the screws drive the clamping plates 7 to be clamped at the edges of the operating bed, and the whole device is fixed on the operating bed.

After the chest is opened, the front and rear positions of the spreading plates 2 are adjusted according to the chest opening position of the patient. Specifically, the motors 61 are turned on to drive the screws 62 to rotate, and the sliding blocks 63 drive the spreading frames 35 to move forward and backward through the threaded fit between the screws 62 and the sliding blocks 63, thereby flexibly adjusting the front and rear positions of the spreading plates 2 according to the chest opened position. After the spreading plates 2 are adjusted to appropriate positions, the motors 61 are turned off.

The spacing between the spreading plates 2 is adjusted according to the size of the surgical field to be exposed, and the initial adjustment is achieved through the threaded holes 8 on the spreading frames 35.

In order to achieve further fine adjustment, when the handle 47 is manually lifted, the handle 47 drives the piston rod 46 to move upward along the piston cylinder 45, the pressure in the piston cylinder 45 decreases, the liquid stopping balls 52 in the liquid outlet channel 442 move upward, the springs B are compressed, and the hydraulic oil in the hydraulic outer cylinder 41 enters the piston cylinder 45 through the liquid outlet channel 442.

Further, by pressing down the handle 47, the hydraulic oil in the piston cylinder 45 enters the hydraulic inner cylinder 42 through the liquid inlet channel 441. In this way, the handle 47 is repeatedly lifted and pressed down several times, and the hydraulic oil in the hydraulic inner cylinder 42 pushes the hydraulic column 43 to move upward along the hydraulic inner cylinder 42.

With the upward movement of the hydraulic column 43, the hydraulic column 43 pushes the movable rods 33 to move to two sides, and the movement of the movable rods 33 drives the chest opening brackets 34 to move, thereby causing the spreading frames 35 to drive the spreading plates 2 to move, achieving the adjustment of the distance between the two spreading plates 2,and achieving the supporting and fixing of the sternum on two sides

of the patient, which facilitates the surgery by the doctor.

After surgery, patients are closely monitored for vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation, as well as wound healing, and are prescribed to take antibiotics to prevent infection, anticoagulants or antiplatelets to prevent thrombosis, and cardiotonics or diuretics to help restore heart function.

It is to be noted that various changes and modifications could be made by those skilled in the art without departing from the scope of the present invention, which are also regarded as the protection scope of the present invention, and these will not affect the implementation effect of the invention and the practicability of the patent. The scope of protection required by this application shall be subject to the contents of the claims, and the specific embodiments in the specification can be used to explain the contents of the claims.