STERNAL CLAMP WITH RIB EXTENSION

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ABSTRACT
A sternal closure clamp device for securing and retaining longitudinally divided halves of a sternum, the device having a pair of body members each having engagement members adapted to abut the sides of the sternal halves, and at least one rib extension member having rib retaining means attached to at least one of said body members, such that the rib extension member can be secured to a rib to reduce the force being applied directly to the sternal halves.
STERNAL CLAMP WITH RIB EXTENSION


BACKGROUND OF THE INVENTION

[0002] This invention generally relates to devices used to rejoin a human sternum that has been severed longitudinally, and more particularly relates to such devices that function in a clamping manner to retain the severed sternum portions in a closed and abutting relationship post-operatively.

[0003] It is often necessary in surgical operations to longitudinally sever the patient’s sternum so that the ribs may be spread to provide access to internal organs such as the heart. It is then necessary to secure the sternum halves together for post-operative recovery. Various closure techniques are used to accomplish this task. For example, holes may be drilled into the sternum halves and suture material passed through and tightened to cinch the sternum halves together. Apertured plates may be added to further rigidly the sternum post-operatively, with the suture material being passed through the apertures in the plate and the sternum. Encircling members may be wrapped around the sternum and tightened. Toothed bridging members extending across the cut line may be pressed into the sternum surfaces and/or secured with threaded rods extending between the sternum halves.

[0004] Another sternal closure technique involves the use of clamps having hook-like projections or engagement members on both ends, the clamp being positioned laterally relative to the sternal incision with the projections being disposed between adjoining rib pairs on opposite sides of the sternum. The clamp is then linearly contracted or compressed to shorten the device and force the sternum halves together, the clamp typically comprising two members joined in a linearly telescoping manner. Locking or securing means, either permanent or releasable, maintain the clamp in the contracted configuration so that the sternum can heal.

[0005] Examples of such techniques and devices are described in U.S. Pat. No. 3,473,528 to Mishkin et al., U.S. Pat. No. 4,201,215 to Crosette et al., U.S. Pat. No. 4,279,248 to Gabbay, U.S. Pat. No. 4,583,541 to Barry, U.S. Pat. No. 5,139,498 to Astudillo Ley, U.S. Pat. No. 6,051,007 to Hogendijk et al., U.S. Pat. No. 6,217,580 to Levin, U.S. Pat. No. 6,302,899 to Johnson et al., U.S. Pat. No. 6,540,769 to Miller, Ill., and U.S. Pat. No. 6,712,821 to Gabbay the disclosures of which are herein incorporated by reference.

[0006] In certain circumstances, the strength and rigidity of the sternum may be insufficient to withstand the compressive forces of the sternal clamp, such that the sternum may be damaged upon compression of the sternal clamp or such that the weak point requires a deformity in the clamp. It is an object of the invention to provide a sternal closure clamp device having at least one rib extension member such that the clamp may be secured directly to the rib a distance away from the sternum, such that the compressive forces of the sternal clamp are dispersed between the sternum and the rib.

SUMMARY OF THE INVENTION

[0007] The invention is in general a sternal closure clamp device for post-operatively closing, securing and supporting a patient’s sternum that has been longitudinally severed into two sternal halves. The sternal clamp generally comprises two body members each preferably having a pair of spaced, sternum-engaging engagement members extending rearward from the body member.

[0008] The engagement members are means to engage, secure or otherwise retain the sternum halves in an abutting relationship, with the engagement members comprising hooks, projections, fingers or the like extending in the posterior direction, whereby the engagement members can be disposed against the outer edges of the sternum halves and between adjoining ribs, preferably with the two engagement members located on a given side being positioned in the inter-rib spaces to either side of a single rib.

[0009] Extending from at least one of the two body members is a rib extension member, the rib extension member preferably being attached to the body member in a pivoting manner such that the angle of the rib extension relative to the body member can be adjusted. Rib clamping means are provided on the free end of the rib extension arm member such that the device can be securely affixed to the rib.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a front view of an embodiment of the invention.

[0011] FIG. 2 is a front perspective view of a portion of the embodiment of FIG. 1, showing the mounting platform for the rib extension member.

[0012] FIG. 3 is a rear perspective view of the rib extension member of the embodiment of FIG. 1.

[0013] FIG. 4 is a side view of an embodiment of the invention having two rib extension members.

DETAILED DESCRIPTION OF THE INVENTION

[0014] With reference to the drawings, the invention will now be described in detail with regard for the best mode and the preferred embodiment. The invention is a sternal closure clamp device used to close, secure and support a sternum post-operatively, the sternum having been severed longitudinally into left and right lateral sternal halves to provide access to the interior of the chest, wherein the sternal clamp comprises two opposing body members and a rib extension member mounted to at least one of said body members.

[0015] The sternal clamp 10 generally comprises two opposing body members 11 and 12 each at least one and preferably a pair of spaced, sternum-engaging engagement members 13 extending posteriorly from the body members 11 and 12. The body members 11 and 12 are slidably or telescopically interconnected such that the overall length of the sternal clamp 10 can be adjusted. The engagement members 13 are means to engage, secure or otherwise retain the sternum halves in an abutting relationship, with the engagement members 13 comprising hooks, projections, fingers or the like extending in the posterior direction from the main bodies 11 and 12, whereby the engagement members 13 are able to be disposed against the outer edges of the sternum halves and between adjoining ribs, preferably with the two engagement members 13 located on a given side being positioned in the inter-rib spaces to either side of a single rib. In use, the clamp 10 is positioned on the sternum halves across the longitudinal sternal incision with the engagement members 13 located in the inter-rib spaces, such that at least one rib is between the two engagement members 13 on a given side of the clamp 10.
The sternal halves and opposing body members 11 and 12 are forced or drawn together to close the longitudinal incision, such that the sternal halves are retained in an abutted relation by the engagement members 13 and precluded from separating, the clamp 10 comprising means (not shown) to retain or lock the clamp 10 in the compressed or contracted position, such as a mechanical fastener, ratchet mechanisms, springs or the like. Such sternal clamps are well known in the art.

To address the circumstances where the sternum bone material is not strong enough to withstand the compressive force of the sternal clamp 10, due to age, injury, disease or the like, the sternal clamp 10 comprises a rib extension member 21 attached to at least one body member, herein shown in FIGS. 1 and 2 as attached to body member 12. A second rib extension member 21 could also be attached to body member 11, as shown in FIG. 4, or alternatively plural rib extension members 21 could be mounted on one side. The rib extension member 21 may be rigidly affixed to the body member 12, but preferably is mounted onto body member 12 by means 30 for pivoting the rib extension member 21 such that the relative angle between the rib extension member 21 and body member 12 can be altered. As a representative non-limiting example, in the drawings the pivot means 30 is shown to comprise an apertured base plate member 31 positioned on the body member 12, an apertured arm plate member 32 positioned on the end of arm member 22, and fastener means 33, such as a screw, designed to secure the arm plate member 32 to the base plate member 31.

The rib extension member 21 further comprises rib securing means 23 positioned on the free end of arm member 22, the rib securing means 23 being means for securing the rib extension member 21 directly to a rib at a point distanced from the sternum and body member 12. Rib securing means 23 may comprise any suitable clamping or fastening structure, and a non-limiting representative example is shown in the drawings to comprise at least one fixed projection or leg member 24, an adjustable projection or leg member 25 and securing means 26, such as a screw, that allows the legs 24 and 25 to be clamped tightly onto the rib by spreading apart or extending the leg members 25 and 26, forcing them together to securely abut the rib, and locking them in place about the rib.

To utilize the device, the clamp 10 is extended and placed about the sternal halves such that the projection members 13 abut the outer sides of the sternal halves. Arm member 22 may be angled or curved toward the front or rear to conform to the position of the rib to which it will be attached. The rib extension member 21 is pivoted to properly align it with the rib and the rib securing means 23 are secured to the rib. The sternal halves are then drawn together and the clamp 10 is locked so that it cannot be extended. In this manner, the compressive force of the sternal clamp 10 is divided between the sternum and the rib (or ribs) when the clamp 10 is positioned about the sternal halves and contracted, as opposed to being completely concentrated against the sternal bone.

It is understood that equivalents and substitutions to elements set forth above may be obvious to one of ordinary skill in the art, and therefore the true scope and definition of the invention is to be as set forth in the following claims.

We claim:

1. A sternal closure clamp for holding the sternal halves of a longitudinally severed sternum in abutting relation, said clamp comprising:

   a pair of slingly interconnected body members whereby the overall length of said clamp is adjustable and whereby said body members can be locked into a fixed relative position;

   at least one sternal engagement member connected to each said body member, said sternal engagement members extending to the rear of said body members and;

   at least one rib extension member connected to said at least one of said body members, said rib extension member comprising means for securing said rib extension member directly onto a rib;

   whereby with said sternal engagement members positioned abutting the sides of a severed sternum, said rib extension members are securable directly onto a rib in order to reduce the force applied to a sternum by said sternal engagement members when the sternal clamp is contracted.

2. The clamp of claim 1, wherein said at least one rib extension member is angularly adjustable relative to said at least one of said body members.

3. The clamp of claim 1, further comprising another rib extension member, wherein each of said rib extension members is connected to a different said body member.

4. The clamp of claim 3, wherein both of said rib extension members are angularly adjustable relative to said body members.

5. The clamp of claim 1, comprising a pair of sternal engagement members connected to each said body member, said sternal engagement members being spaced apart such that a rib may be received therebetween.

6. The clamp of claim 5, wherein said at least one rib extension member is angularly adjustable relative to said at least one of said body members.

7. The clamp of claim 5, further comprising another rib extension member, wherein each of said rib extension members is connected to a different said body member.

8. The clamp of claim 7, wherein both of said rib extension members are angularly adjustable relative to said body members.

9. A sternal closure clamp comprising:

   a pair of slingly interconnected body members whereby the overall length of said clamp is adjustable;

   at least one sternal engagement member connected to each said body member;

   a rib extension member connected to one of said body members, said rib extension member comprising means for securing said rib extension member directly onto a rib;

   whereby said rib extension member are securable to a rib in order to reduce the force applied to a sternum by said sternal engagement members when the sternal clamp is contracted.

10. The clamp of claim 9, wherein said rib extension member is angularly adjustable relative to said one of said body members.

11. The clamp of claim 9, wherein a second rib extension member is connected to the other of said body members.

12. The clamp of claim 11, wherein said rib extension member is angularly adjustable relative to said one of said body members and wherein said second rib extension member is angularly adjustable relative to said other of said body members.

13. The clamp of claim 1, comprising a pair of sternal engagement members connected to each said body member,
said sternal engagement members being spaced apart such that a rib may be received therebetween.

14. The clamp of claim 13, wherein said rib extension member is angularly adjustable relative to said one of said body members.

15. The clamp of claim 13, wherein a second rib extension member is connected to the other of said body members.

16. The clamp of claim 15, wherein said rib extension member is angularly adjustable relative to said one of said body members and wherein said second rib extension member is angularly adjustable relative to said other of said body members.