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SURGICAL CLAMP

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4 Claims. (Cl. 128—322)

This invention relates to surgical clamps for blood vessels and the like.

The foremost barriers to head and neck surgery are the high mortality and the neurological sequelae which follow prolonged occlusion or ligation of the common and internal carotid arteries. Such prolonged occlusion or ligation occurs when employing the previously known techniques and clamps wherein total occlusion of the arteries is provided by clamps positioned transversely across the arteries so as to isolate the section of the artery to be removed or repaired.

It is therefore an object of this invention to provide a new and improved surgical clamp for only partially occluding blood vessels, particularly the common and internal carotid arteries, so as to permit the insertion of a shunt therein to temporarily by-pass the blood around the section of the blood vessel to be replaced or repaired, whereby substantially no reduction in the normal blood flow occurs during such replacement or repair.

Another object of this invention is to provide a new and improved surgical clamp for providing only partial occlusion of a blood vessel while isolating a portion of the vessel for the suturing of a rupture therein without reducing the distal blood flow, and for other instances wherein it is desirable or necessary to isolate a portion of the vessel without reducing the distal blood flow.

A particular object of this invention is to provide a new and improved surgical clamp having relatively thin jaw sections with teeth thereon for gripping a relatively small blood vessel (the size of the internal or the external carotid arteries) longitudinally thereof, said jaw sections also having interlocking fixation means to prevent "scissoring" or shifting of the jaw sections relative to each other while applying clamping pressure to the jaw sections for bringing the walls of a portion of the blood vessel into contact with each other.

A further object of the invention is to provide a new and improved surgical clamp having substantially J-shaped jaw sections which are connected together at a pivot joint and which are moved toward and away from each other by handle sections extending upwardly therefrom, said J-shaped jaw sections having teeth thereon which are adapted to engage the exterior of a blood vessel without puncturing same, and said clamp also having interfitting fixation means at the outer end of each jaw section and extending above the vessel and out of contact therewith when the jaw sections are in gripping engagement therewith to prevent the jaw sections from "scissoring" or shifting relative to each other.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

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Fig. 1 is an elevation of the new and improved surgical clamp of this invention.

Fig. 2 is a plan view of the surgical clamp of this invention.

5 Fig. 3 is a view taken on line 3—3 of Fig. 1 to illustrate in particular the relationship between the gripping teeth on the jaw sections and the interfitting fixation means at the ends of the jaw sections.

10 Fig. 4 is an end view taken on line 4—4 of Fig. 3, and it particularly illustrates the construction of the interfitting fixation means which forms a part of the surgical clamp of this invention.

Fig. 5 is a sectional view taken on line 5—5 of Fig. 3.

In the drawings, the letter A designates generally the surgical clamp of this invention which is adapted to be used for the partial occlusion of the common and internal carotid arteries or other blood vessels B, particularly those of medium and relatively small caliber. The surgical clamp A includes a pair of jaw sections 10, each of which is substantially J-shaped, as will be explained more fully hereinafter. The jaw sections 10 are connected together at pivot means 12, which is preferably a box or mortise joint, for movement toward and away from each other. Handle arms 14 are provided for effecting the movement of the jaw sections 10 toward and away from each other about the pivotal connection or joint 12. Each of the arms 14 is a continuation of one of the jaw sections 10. A ratchet type locking means 15 is provided between the arms 14 to lock the jaw sections 10 under increasing amounts of pressure as the arms 14 are moved towards each other during the gripping with the jaw sections 10 on a blood vessel B or the like. At the forward ends of the jaw sections 10, an interfitting fixation means 16 is provided for preventing "scissoring" or shifting of the jaw sections 10 as they are moved toward each other during the clamping of the vessel B, whereby puncturing or other damage to the vessel B is avoided. Thus, with such fixation means 16, as will be more fully explained hereinafter, the jaw sections 10 are prevented from shifting during their movements toward and away from each other even though such jaw sections are made relatively thin or narrow for use on the carotid arteries.

45 Considering the invention in more detail, each of the jaw sections 10 includes a plurality of teeth 20 which are adapted to interfit with the teeth 20 on the opposite jaw section 10 when the jaw sections 10 are moved together. Each tooth 20 preferably has a depth or length of from about .015 of an inch to about .030 of an inch, although such depth or length of each tooth may vary so long as the teeth do not rupture into the intima or inner lining of the blood vessel with which the clamp is used. Each tooth 20 is preferably formed with a point, wherein the transversely extending walls are at an angle of about 25° to about 35°, but preferably at about 30° as indicated in Fig. 3 of the drawings. Such angle of the transversely extending side walls of each tooth 20 may be varied, but preferably the foregoing range of angles is provided. The longitudinally extending walls of each tooth 20 converge towards the pointed end of each tooth at an angle of from about 15° to about 25°, with the angle of about 25° being preferred as indicated in Fig. 5. Again, such angle may be varied for various conditions. However, the foregoing angles and sizes with respect to the teeth 20 are important since they assure the provision of teeth 20 which will indent or impress the outer surface of the vessel B without puncturing or rupturing same during the gripping of such vessel.

70 Each jaw section 10 is provided with a first portion 10a, each of which is adapted to extend substantially

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longitudinally or axially with respect to the vessel B during the clamping thereof. A second or forward portion 10b of each jaw section 10 extends upwardly and forwardly with respect to the first portion 10a at an angle of from about 115° to about 125°, and preferably at an angle of about 120° as indicated in Fig. 1. The second or forward portion 10b of each jaw section 10 is the shorter leg of the J-shape, and the interfitting fixation means 16 is provided at the upper ends of the forward portions 10b so that such fixation means 16 is positioned above and out of contact with the vessel B when the clamp A is in use.

Each jaw section 10 also has a third or rearward portion 10c which extends upwardly and rearwardly from each first portion 10a at an angle of from about 100° to 120°, and preferably at an angle of about 110° as indicated in Fig. 1 of the drawings. It can be seen from Fig. 1 that each rearward or third portion 10c forms the longer leg of the J-shape of each jaw section 10, and in the ordinary case, the rearward portions 10c are approximately 1½ inches to about 2 inches in length to facilitate the positioning of the clamp A lengthwise of the vessel B. The jaw portions 10a may vary in length from about ½ inch to about 1 inch, depending upon the portion of the blood vessel requiring clamping.

The handle arms 14 extend rearwardly and upwardly from the third portions 10c of the jaw sections 10 at an angle of from about 120° to about 140° with respect to such third portions 10c, and preferably at an angle of about 130° as indicated in Fig. 1 of the drawings. Such upward inclination of the arms 14 facilitates the use of the clamp on blood vessels disposed relatively large distances below the skin, and more specifically, the common and internal carotid arteries in the neck. Such upward inclination of the arms 14 further facilitates the location of the jaw sections 10 lengthwise of the vessel B during the clamping operation. Each of the handle arms 15 has a handle ring 19 formed therewith for receiving a finger and the thumb of the surgeon using the clamp A. Such handle rings 19 preferably lie in the same plane as the handle arms 14. The pivotal connection 12 also lies in the same plane as the handle arms 14 and is of a conventional construction, preferably of the box or mortise joint type with a rivet or pivot pin 22 extending through the joint 12. In some instances, the pivotal connection 12 may be located between the third or rearward portions 10c of the jaw sections 10 so as to lie in the plane therewith rather than in the plane with the handle arms 14 as shown in the drawings. Such will ordinarily be the construction when the clamp A is reduced in size for use on smaller blood vessels.

The ratchet locking means 15 is of a conventional construction and includes a ratchet tooth member 23 which may have one or more ratchet teeth and which is adapted to cooperate with a plurality of ratchet teeth 25. As the handle arms 14 are moved towards each other, the ratchet tooth member 23 slides over the ratchet teeth 25 so as to successively lock the handle arms 14 closer together until the maximum pressure is applied to the jaw sections 10. Such ratchet lock means 15 is released in a known manner by shifting the handle rings 19 and thus the arms 14 vertically with respect to each other so that the ratchet tooth 23 can be moved away from the ratchet teeth 25 to separate the arms 14.

The interfitting fixation means 16 at the forward ends of the jaw sections 10 includes an inwardly extending projection or tooth 30 which is affixed or formed integrally with one of the jaw sections 10 for interfitting within a recess 31 formed in the other of the jaw sections 10. The width of the projection 30 is substantially the same throughout its length, and the width of the recess 31 is also substantially the same throughout its length and is only slightly larger in width than the projection 30. Thus, as the projection 30 moves into the recess 31, very little

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shifting movement, if any, of the jaw sections relative to each other is possible because of the relatively narrow clearance between the external surface of the tooth 30 and the wall or inner surface of the recess 31. This condition exists from the time that the tooth 30 enters the recess 31 until it is fully telescoped or seated in such recess 31.

The tooth 30 actually enters the recess 31 prior to the time the tooth 23 locks with the first of the teeth 25 on the ratchet locking means 15. Therefore, prior to the time that any appreciable gripping force is applied to the jaw sections 10 on the vessel B with which the clamp A is used, the projection 30 is in the recess 31 and therefore "scissoring" or shifting of the jaw sections 10 with respect to each other as they are moved towards each other is avoided or prevented. Since the construction of the interfitting fixation means 16 prevents substantially all shifting of the jaw sections 10 relative to each other, the teeth 20 may be relatively sharp or pointed for indenting or impressing the outer surface of the vessel B without creating the danger of rupturing or puncturing the wall of the vessel B. Such situation is extremely important in surgical clamps, and particularly in a clamp which is positioned lengthwise of the blood vessel B and which has relatively thin jaw sections which are more subject to flexing and shifting as they are moved towards each other.

In the use of the clamp A of this invention, it is positioned as illustrated in Fig. 1 with the first or lower portions 10a of the jaw sections 10 substantially longitudinal or axial with respect to the vessel B and at a position on the vessel B so as to obtain between about 30% to about 55% occlusion of the blood flowing through the vessel. Of course, the amount of occlusion can be varied, but it is necessary from a surgical standpoint to limit the amount of the occlusion to no more than about 55%, particularly when dealing with arteries flowing blood to the brain. Each jaw portion 10a is built no thicker than about ¼ inch to effect minimum occlusion of blood flow through the blood vessel with maximum exposure of the portion of the blood vessel to be operated upon. The interfitting fixation means 16 extends above the upper surface of the vessel B so that the projection 30 does not puncture or contact the vessel B at any time. The fixation means 16 prevents the shifting of the jaw sections 10 as the jaw sections 10 are moved toward each other by the movement of the handle arms 14. As previously mentioned, the fixation means 16 is effective prior to the time that the ratchet locking means 15 begins to function so that there is no opportunity for a shifting of the jaw sections 10 as the gripping pressure is applied with the jaw sections 10 to the vessel B. The portion of the vessel B identified by the letter X (Fig. 1) above the jaw sections 10 is completely cut off from the flow of blood and is isolated from the rest of the vessel B so that an incision may be made for the subsequent insertion of a tube to effect the by-pass of blood there-through. Thus, with the clamp A of this invention, such incision can be made without causing any loss of blood and by reason of the fixation means 16, no "scissoring" or shifting of the jaw sections 10 occurs as the vessel B is clamped to isolate such section X.

It should be pointed out that the size of the clamp A may be varied for use in connection with different sizes of vessels or arteries, but ordinarily, the rear or third portions 10c of the jaw sections 10 remains substantially the same length, namely, about one and one half inches to about two inches so as to permit the positioning of the jaw sections 10 on the vessel B. Also, as previously mentioned, the pivotal connection 12 may be located between the rearward portions 10c of the jaw sections 10 and in the same plane therewith instead of in the plane with the handle arms 14 as illustrated in the drawings. In this connection, it should be pointed out that although there are teeth 20 on the rearward portion 10c, they do not ordinarily extend upwardly beyond the height

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of the forward or second portions 10b of the jaw sections 10.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A surgical clamp for partial occlusion of blood vessels and the like, comprising a pair of opposed jaw sections adapted to be positioned lengthwise of a blood vessel and having teeth thereon which interengage when the jaw sections are brought together, said teeth being of a length to indent the vessel without rupturing same, pivot means pivotally connecting said jaw sections together for movement towards and away from each other, a handle arm joined with each jaw section for forming an extension thereof beyond said pivot means to effect the movements of said jaw sections towards and away from each other, said jaw sections each having a first portion adapted to extend longitudinally of the vessel, a second portion extending upwardly and forwardly at an angle of from about 115° to about 125° from said first portion, and a third portion extending upwardly and rearwardly at an angle of about 100° to about 120° from said first portion, said handle arms extending rearwardly at an angle of from about 120° to about 140° from said third portion, and interfitting fixation means at the upper ends of said second portions of said

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jaw sections extending above the vessel being gripped by said jaw sections for preventing shifting of the jaw sections as they are moved towards each other in applying clamping pressure to the vessel during the partial occlusion of same.

2. The structure set forth in claim 1, wherein said fixation means includes an elongate recess on one of said jaw sections which is substantially the same width throughout its depth, and an elongate projection on the other jaw section adapted to extend into said recess and which is slightly narrower in width throughout its length than said recess whereby the alignment of said projection in said recess is assured and maintained from the time the projection is initially inserted into said recess until the projection contacts the bottom of said recess.

3. The structure set forth in claim 1, wherein the teeth on each jaw section are from approximately 0.015 of an inch to approximately 0.030 of an inch in height to prevent puncture of the intima of the vessel when gripping same.

4. The structure set forth in claim 1, wherein said interfitting fixation means includes a notched element on one of said jaw sections and a projection on the other jaw section, both of which extend inwardly towards each other to interfit prior to the application of a squeezing force to said vessel with said jaw sections.

References Cited in the file of this patent

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