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(71) Applicant(s)

Raymond Thal

(72) Inventor(s)

Thal, Raymond

(74) Agent/Attorney

Cullens Patent and Trade Mark Attorneys, Level 32 239 George Street, Brisbane, QLD, 4000

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(71) Applicant and
(72) Inventor *(for all designated States except US)*: **THAL, Raymond** [US/US]; 1029 Founders Ridge Lane, McLean, VA 22102 (US).

(74) Agent: **MCDONALD, Christopher, J.**; Hoffman, Wasson & Gitler, P.C., Suite 522, 2461 South Clark Center 2, Arlington, VA 22202 (US).

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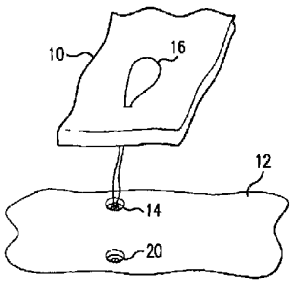
(54) Title: SLEEVE AND LOOP MULTIROW REPAIR



(57) Abstract: A tissue repair has at least two attachment points for a suture to create a broad area of contact between tissue in bone. When two anchor points are used, the suture extends between and is attached to the two attachment points to create a suture band. When two on more attachment points are used, a first anchor point in the bone has one or more loops. The first anchor point is preferably located on a medial location at the repair site when performing rotator cuff repair. For other types of repair procedures, the first anchor point is different and located as required. The loop or loops are passed through the soft tissue at points spaced from one another. The loop or loops are then captured and secured at anchor points laterally during rotator cuff repair and spaced from the first anchor point and from one another. When complete, the loop or loops are in the form of a "V" and a large area of contact between the soft tissue and bone is established. When more than two loops are used, each loop extends from the first attachment point to another attachment point.

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SLEEVE AND LOOP MULTIROW REPAIR

The application claims the benefit of priority from US provisional application 60/617,640, filed 13 October 2004.

Background of the Invention

Mere reference to background art herein should not be construed as an admission that such art constitutes common general knowledge in relation to the invention.

Arthroscopic procedures often require soft tissue to be reattached to bone. To achieve this, anchors are placed in the bone and sutures attached to the anchor are passed through the tissue to securely retain the tissue in place. The prior art has developed knotless suture anchors, such as those disclosed in U.S. Patents 5,569,306, 5,658,313, 5,665,112, 5,709,708 and 6,045,574, the disclosures of which are incorporated herein by reference.

When making a repair of soft tissue to bone, it is advantageous to have as large an area of contact between the bone and tissue as possible. Anchor points spaced from one another in rows result in a repair having a broader area of contact. There is a need in the art for a procedure that securely attached tissue to bone over a large area of contact. The procedure must use existing components and be able to be done in a quick efficient manner with a minimum of recovery time for the patient.

It is an object of the invention to reattach tissue to bone over a large contact area.

It is another object of the invention to provide a procedure to reattach tissue to bone using a plurality of attachment points.

It is still another object of the invention to have a tissue repair avoiding arthroscopic knot tying.

It is yet another object of the invention to provide a procedure to reattach tissue to bone minimizing both the operative time and the patient's recovery time.

These and other objects of the invention will be apparent to one of ordinary skill in the art after reading the disclosure of the invention.

Summary of the Invention

According to an aspect of the invention, there is provided a method of repairing tissue comprising the steps of:

creating a first attachment point for insertion of a first anchor in bone,

inserting said first anchor in said first attachment point, wherein said first anchor is in a form of a hollow cylindrical sleeve and has a first suture loop and a second suture loop attached thereto and extending therefrom,

creating a second attachment point in the bone spaced apart from the first attachment point,

creating a third attachment point spaced apart from the first and second attachment points,

passing the first suture loop through the tissue and then capturing the first suture loop with a second anchor and inserting the second anchor into said second attachment point, and

passing the second suture loop through the tissue and capturing the second suture loop with a third anchor and inserting the third anchor into the third attachment point,

wherein said second and third anchors comprise a knotless compression anchor or a ratcheting anchor assembly.

The method of repairing tissue involves at least two attachment points for a suture to create a broad area of contact between tissue and bone. When two anchor points are used, the suture extends between and is attached to the two attachment points to create a suture band. When two or more attachment points are used, a first anchor point in the bone has one or more loops. The first anchor point is preferably located on a medial location at the repair site when performing rotator cuff repair. For other types of repair procedures, the first anchor point is different and located as required. The loop or loops are passed through the soft tissue at points spaced from one another. The loop or loops are then captured and secured at anchor points laterally during rotator cuff repair and spaced from the first anchor point and from one another. When complete, the loop or

loops are in the form of a "V" and a large area of contact between the soft tissue and bone is established. When more than two loops are used, each loop extends from the first attachment point to another attachment point.

Brief Description of the Drawings

Figure 1 depicts a multirow repair;

Figure 2 shows the completed repair of Figure 1;

Figure 3 depicts a repair with one anchor point having two loops passing through the tissue;

Figure 4 depicts the completed repair of Figure 3;

Figure 5 depicts an alternative embodiment of the anchor having a single loop attached to two attachment points;

Figure 6 depicts the first step in another type of multiple repair configuration;

Figure 7 depicts a threaded anchor usable with the invention;

Figure 8 depicts the anchor of Figure 7 retaining two loops;

Figure 9 depicts a anchor with two loops and plug capturing one loop;

Figure 10 depicts the first step in performing a multirow repair;

Figure 11 depicts the second step in a multirow repair;

Figure 12 depicts the final configuration of a multirow repair;

Figure 13 depicts the second step in a multirow repair using a plug and sleeve anchor;

Figure 14 depicts the final configuration in the multirow repair of Figure 13.

Detailed Description of the Invention

Figure 1 shows tissue **10** needing to be reattached to bone **12**. A first attachment device **14** retains a suture loop **16**. A loop may comprise a complete circle of sutures or a strand of suture appearing as a loop when attached to the repair device. The suture passes through the tissue as seen in Figure 1. To complete the repair, the end of the suture loop 16 is attached to a second attachment point **20** laterally spaced from the first attachment device **14**. The second attachment point **20** may be a sleeve receiving a plug that retains the loop. The prior at discloses plugs that capture suture loops and are retained in sleeves but these devices have the suture attached to the same sleeve as retains the plug. In the instant procedure, the suture is attached at a point spaced from the sleeve.

The completed repair is seen in Figure 2 with the end of the suture loop **16** secured to the attachment point **20** to create a band between the two attachment points and over the tissue to create a broad area of contact between bone and tissue.

Figure 3 shows tissue **10** needing to be reattached to bone **12**. A first attachment device **14** retains a first loop **16** and a second loop **18**. More than two loops may be used for a repair, as will be explained later. This strand produces an effective loop attached at any location on the repair device or molded to or with the device. Laterally spaced from the first attachment device **14** and spaced from one another are a second attachment point **20** and a third attachment point **25**. As seen in Figure 4, after the loops **16** and **18** have been attached to the second attachment point **20** and third attachment point **25**, respectively, the tissue is held against the bone with the loops **16**, **18** extending over the edge of the tissue. Alternatively, one or more of the loops can be repassed through the tissue one or more times prior to attachment to one of the second or third attachment points.

A third embodiment is seen in Figure 5. The first anchor **114** has a single long suture **116** passing through the tissue at two different points. The single suture is attached to two different attachment points **120,125** to secure the tissue to the bone.

For extensive repairs along greater lengths of bone and tissue, several of the repairs comprising a first attachment device and a second and third attachment point can be used in series. One possible configuration for a multiple repair is depicted in Figure 6. When two first attachment points **14** are used, one loop from each first attachment point may be secured into a common attachment point **23**. The remaining loop from each first attachment point is then secured to a separate attachment point **20,25**. In this configuration, one less anchor point is needed as the common anchor point **23** secures loops from two different first attachment points **14**.

The first attachment device may be a sleeve or a screw-in anchor, each having one or more attached loops. Any type of anchor with one or more loops may be used. One possible device is shown in Figure 7, consisting of a threaded sleeve **27** made of any suitable material such as polypropylene. Figure 8 shows the sleeve **27** retaining two loops and a sleeve driver **32** having two suture channels. The loops are attached to the anchor by any conventional means, such as molding the two ends of a suture to the anchor. Figure 9 depicts a plug **31** having a notch at its distal end for capturing one of the suture loops.

Figure 10 depicts, in approximate cross section, the first attachment point **14**. For clarity purposes only one loop **16** is shown extending through tissue **10**. A second attachment point **20** is formed in the bone **12**, as shown in Figure 11. The loop is captured by an anchor **131**. The anchor may be any type of anchor having bone gripping properties, such as the illustrated compression anchor. In the specific anchor shown, a slot on the end of the anchor retains the loop.

Figure 12 shows the loop, captured by the anchor **39**, retained in the second attachment point **20**. The same procedure is repeated for the second loop **18** to be retained in the third attachment point **25**.

Figure 13 is a view similar to Figure 11 but showing the repair made with a plug and sleeve anchor. One type of sleeve anchor is disclosed in US patent 6,045,574. While this patent discloses the connection between the sleeve and plug, the sleeve in the instant procedure receiving the plug does not have the suture attached to it. In this view, the sleeve **127** has been placed within the bore drilled into the bone and the plug **131** captures the loop **16**.

Figure 14 shows the plug **131** placed within the outer sleeve **127** in the attachment point **20**, thereby capturing the loop **16** to create a stable, effective repair. The sleeve may be secured within the bore by any suitable means such as threads (shown), wedges or prongs. Another type of anchor enables the anchor to ratchet down inside of the sleeve to ensure the tightness of the repair.

The type of anchor used for the first attachment device **14** and in the second and third attachment points **20**, **25** can be chosen from the many types of anchors in the existing art and are dictated by bone density, location of repair and surgeon preference. Regardless of the specific type of anchor, a two row repair with one or more attachment points laterally spaced from a first attachment device having one of more loops is established, resulting in a repair having greater integrity and long term stability.

While the invention has been described with reference to preferred embodiments, variations and modifications would be apparent to one of ordinary skill in the art. The invention encompasses such variations and modifications.

Throughout this specification, including the claims, where the context permits, the term "comprise" and variants thereof such as "comprises" or "comprising" are to be interpreted as including the stated integer or integers without necessarily excluding any other integers.

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The claims defining the invention are as follows:

1. A method of repairing tissue, the method comprising the steps of:

creating a first attachment point for insertion of a first anchor in bone,

inserting said first anchor in said first attachment point, wherein said first anchor is in a form of a hollow cylindrical sleeve and has a first suture loop and a second suture loop attached thereto and extending therefrom,

creating a second attachment point in the bone spaced apart from the first attachment point,

creating a third attachment point spaced apart from the first and second attachment points,

passing the first suture loop through the tissue and then capturing the first suture loop with a second anchor and inserting the second anchor into said second attachment point, and

passing the second suture loop through the tissue and capturing the second suture loop with a third anchor and inserting the third anchor into said third attachment point,

wherein the second and third anchors comprise a knotless compression anchor or a ratcheting anchor assembly.

2. The method of repairing tissue of claim 1, wherein said second and third anchors comprise a sleeve and plug anchor assembly.

3. The method of repairing tissue of claim 2, wherein said plug fits within the second and third attachment points with a ratchet connection.

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4. The method of repairing tissue of claim 1, wherein said first suture loop and said second suture loop are molded to an end of said first anchor.

5. The method of repairing tissue of claim 1, further comprising the steps of:

creating a fourth attachment point in bone,

capturing a third suture loop attached to said second anchor in said fourth attachment point,

creating a fifth attachment point in bone, and

capturing a fourth suture loop attached to said third anchor in said fifth attachment point.

6. A method of repairing tissue substantially as hereinbefore described with reference to the accompanying drawings.

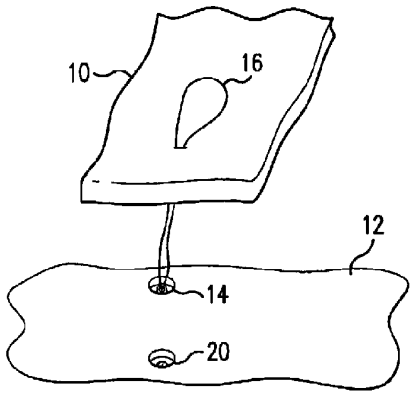

FIG. 1

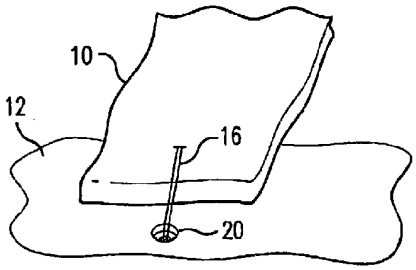

FIG. 2

SUBSTITUTE SHEET (RULE 26)

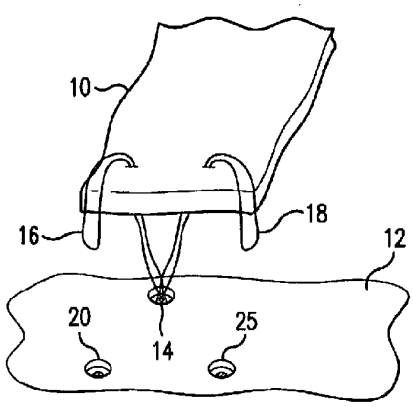

FIG.3

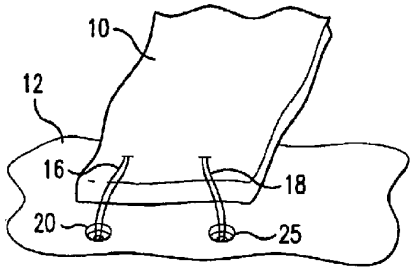

FIG.4

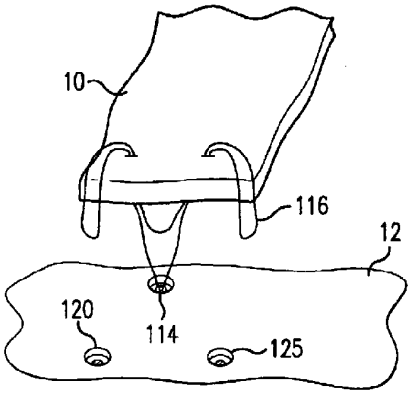

FIG.5

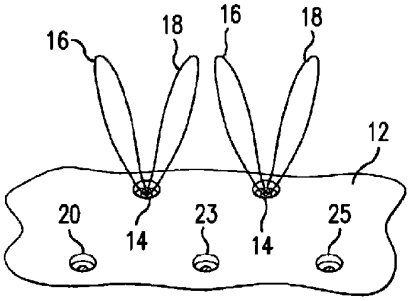

FIG.6

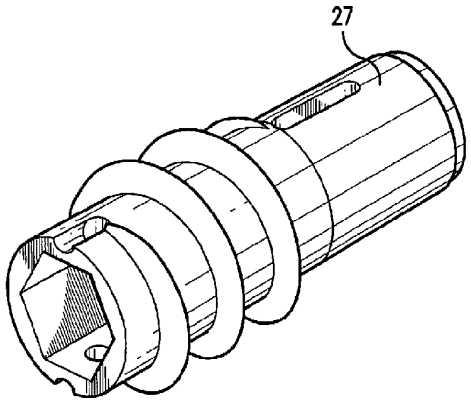

FIG.7

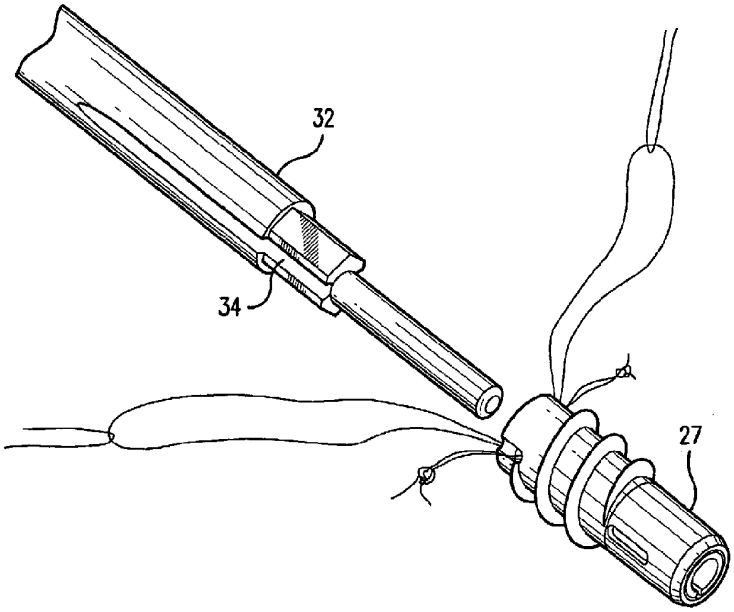

FIG.8

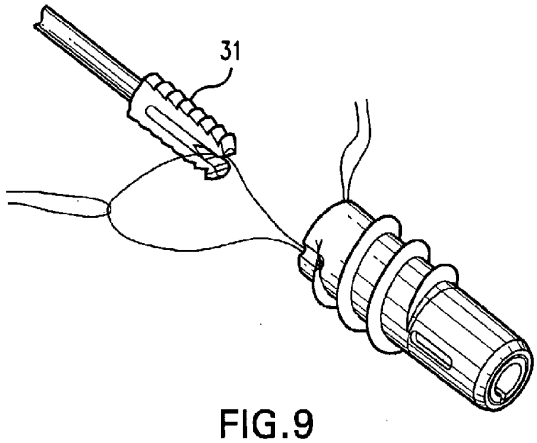

FIG.9

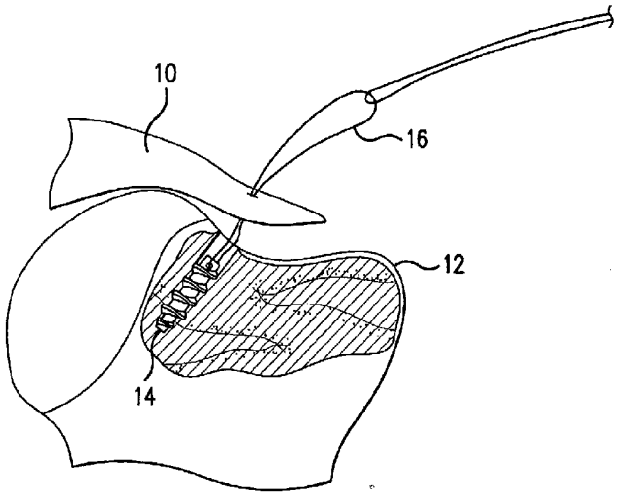

FIG.10

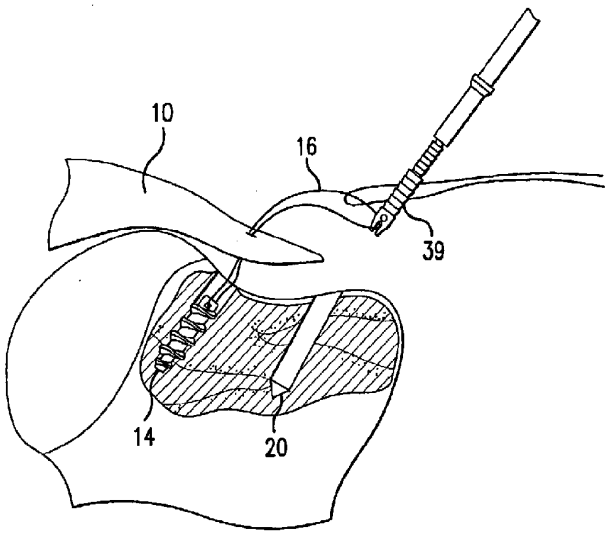

FIG.11

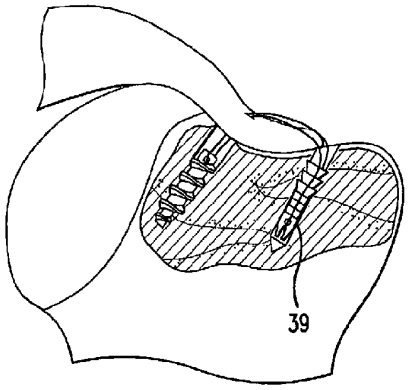

FIG.12

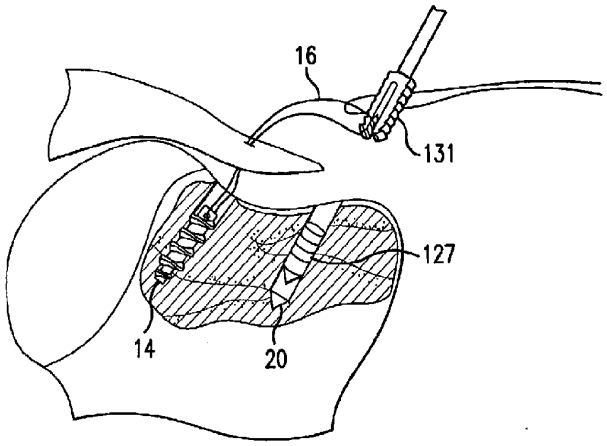

FIG.13

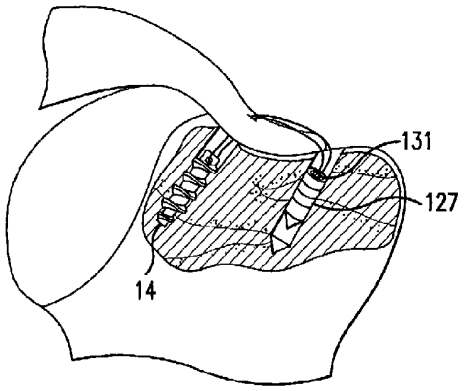

FIG.14