

## **ANCHOR AND SUTURE ASSEMBLY**

### **Field**

The present invention relates to an anchor and a suture assembly for cosmetic enhancement.

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### **Background**

Many devices and methods have been developed over the years for face lift procedures, with the aim to minimise the wounding, scarring and tissue dissection caused by these procedures. One such device is the barbed suture.

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Typically, each suture is stitched through the tissue with a needle, with the barbs oriented away from the needle, in a direction opposite the thread tension. After a number of sutures are inserted in appropriate locations, the facial tissue may then be lifted manually and the barbs would hold the tissue in place in the new configuration. The tension on the suture is then readjusted and the suture secured at a final position with knots. Extraneous suture is cut flush to the knot which is then urged under the skin.

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Generally, some or all of these prior art methods may result in at least two entry/exit wounds per suture, may be subject to single sutures breaking, multiple entry and exit points, each entry and exit point causing scarring and bleeding, significant anaesthetic may be required, and/or the recovery time may be significant.

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Newer solutions provide anchors to secure the suture at a final position under the skin in place of surgically knotting the suture, being therefore less dependent on surgical skill to achieve effective implantation of the suture for a good outcome, and avoiding an exit wound. Anchored sutures face their own problems as soldering or melting the suture to the anchor is not possible due to the heat-sensitive nature of the materials of the suture and anchor. Tying the suture to the anchor is again highly human operator dependent to make knots in the suture, which may give rise to barb damage as a result of significant manipulation of the suture during assembly, and also affect accuracy of implantation position and biodegradation rate of the entire implant due to the presence of suture knots under the skin.

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### **Summary**

In general terms, the present invention proposes a minimally invasive device and technique for cosmetic suturing.

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According to a first aspect, there is provided an anchor for a suture assembly, the anchor comprising: a rigid portion having a closed leading end; a longitudinal blind hole formed in the rigid portion from a trailing end of the rigid portion towards the closed leading end; a transverse through hole formed in the rigid portion, the transverse through hole intersecting the longitudinal blind hole at a distance from an inner surface of the leading end; and a retaining pin configured to be inserted into the transverse through hole to engage the rigid portion; wherein a suture retaining space is defined around the retaining pin in the longitudinal blind hole when the retaining pin is inserted into the transverse through hole and engages the rigid portion, the suture retaining space configured to retain a central portion of a length of suture therein and to allow free ends of the length of suture to extend out of the longitudinal blind hole from the trailing end of the rigid portion.

The transverse through hole may have a cross-section elongated in a longitudinal direction of the anchor.

The retaining pin may have a cuboidal form.

The retaining pin may engage the rigid portion with one of: a locational clearance fit and a locational transition fit.

The transverse through hole may extend through walls of the rigid portion on opposite sides of the longitudinal blind hole.

The retaining pin may have a length sufficient to engage the rigid portion at both ends of the transverse through hole in the rigid portion.

The anchor may further comprise at least two resilient portions projecting laterally from the rigid portion, the at least two resilient portions configured to be displaceable towards a central longitudinal axis of the anchor to allow passage of the anchor through a cannula during implantation of the suture assembly in a patient, the at least two resilient portions further configured to return to their undisplaced positions once the anchor exits the cannula in order to engage facial tissue of the patient to resist movement of the anchor after the anchor is implanted in the patient.

According to a second aspect, there is provided a suture assembly, the suture assembly comprising: the anchor of the first aspect; and a suture, the suture comprising: a single length of suture having two free ends; a central portion between the two free ends; a first barbed portion

on one side of the central portion, the first barbed portion having a first plurality of barbs formed thereon; and a second barbed portion on another side of the central portion, the second barbed portion having a second plurality of barbs formed thereon, wherein the first plurality of barbs and the second plurality of barbs are inclined towards the central portion, wherein the central portion of the suture is in the longitudinal blind hole and retained in the suture retaining space by the retaining pin inserted into the transverse through hole to engage the rigid portion, and wherein the first barbed portion and the second barbed portion extend out of the longitudinal blind hole from the trailing end of the rigid portion.

The retaining pin may apply a pressure on the central portion of the suture in the suture retaining space to create friction between the suture and an inner surface of the rigid portion around the suture retaining space to prevent movement of the suture in the longitudinal blind hole relative to the anchor.

#### **Brief Description of Drawings**

Exemplary embodiments of the invention will now be described, with reference to the following figures:

FIG. 1 is a front view of a patient's facial tissue implanted with a plurality of suture assemblies.

FIG. 2 is a schematic illustration of an exemplary suture of an exemplary embodiment of a suture assembly prior to assembly with an anchor of the suture assembly.

FIG. 3 shows various views of an anchor of the suture assembly.

FIG. 4(a) is a perspective view of an initial position of the suture and anchor and an assembly rod during assembly.

FIG. 4(b) shows a front view and a cross-sectional front view of the suture and anchor during assembly after insertion of a central portion of the suture into the anchor with the assembly rod.

FIG. 4(c) shows the front view and the cross-sectional front view of the suture and anchor during assembly after removal of the assembly rod and after insertion of a retaining pin of the anchor.

FIG. 4(d) is a perspective view of an assembled suture assembly.

#### **Detailed Description**

Embodiments of an anchor 80 and a suture assembly 100 will be described with reference to FIGS. 1 to 4(d), wherein the same reference numerals have been used to indicate the same or similar parts.

Referring to FIG. 1, the suture assembly 100 is designed to effect a distributed lifting force to desired portions of facial tissue of a patient whose face may be subject to rhytides (wrinkles) or ptosis (sagging). The suture assembly 100 may be used to lift tissue in the cheeks 102, temples 104, neck 105 or forehead 106 zones. In each zone, one or more barbed sutures are upwardly  
5 implanted within or under the tissue. An exemplary entry site 108 of the suture assembly 100 is below a final implantation position 112 of an anchor 80 of the suture assembly 100 when the patient is in an upright position, there being no exit site of the suture assembly 100 during implantation. The suture assembly 100 may reduce the number of wounds significantly compared to known methods, and the practitioner is able to provide lift in any location, as there  
10 is no need to provide an exit site at an unobtrusive location. Each entry site 108 may include more than one implanted suture 90, for example, three implanted suture assemblies may be implanted at different angles. Each suture assembly 100 may include a single or multiple sutures 90, which are anchored at the implantation position 112.

15 As shown in FIG. 2, an exemplary suture 90 of an exemplary embodiment of the suture assembly 100 comprises a single length of suture 90 having two free ends 910, 920 and a central portion 93 between the two free ends 910, 920. The suture 90 has a first barbed portion 91 having a first plurality of barbs 911 formed thereon on one side of the central portion 93, and a second barbed portion 92 having a second plurality of barbs 922 formed thereon on another  
20 side of the central portion 93. The first plurality of barbs 911 and the second plurality of barbs 922 are inclined towards the central portion 93 that is preferably free of barbs. The barbs 911, 922 may be provided along the first and second barbed portions 91, 92 on one side of the suture 90 or on both sides, preferably in a staggered configuration, , as depicted in FIG. 2.

25 The suture 90 may be 345mm long. Alternatively, different lengths of the suture 90 may be provided for different zones of the face, or different sized faces, for example 375mm long. The suture 90 may be 0.3mm thick. Alternatively, different thicknesses may be provided for supporting different tensile strengths.

30 The suture 90 may be extruded from materials such as polypropylene, polycaprolactone, polylactic acid or polydioxanone. Some of these materials, such as polydioxanone and polylactic acid, are biocompatible and biodegradable. As such, the face lift effect is temporary and the suture assembly 100 does not stay implanted permanently as it will biodegrade over time. This also reduces risk of complications.

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For all embodiments of the suture assembly 100, the anchor 80 is configured to anchor the suture 90 in place to provide a necessary reaction force to lifting forces provided by the barbs

911, 922 to the facial tissue. The anchor 80 is also configured to allow the suture assembly 100 to be pushed into a cannula (not shown) used for implantation of the suture assembly 100 in the patient.

5 In an exemplary embodiment of the suture assembly 100, as shown in FIGS. 3 and 4 (barbs not depicted), the anchor 80 comprises a rigid portion 88 having a fully closed leading end 81 and an open trailing end 82. The rigid portion 88 preferably comprises a generally cylindrical block having a central longitudinal axis L as shown, although any other suitable shapes may also be used. To secure the suture 90 to the anchor 80, the anchor 80 comprises a longitudinal blind  
10 hole 89 having a specific depth formed into the rigid portion 88 from the trailing end 82 of the anchor 80 towards the leading end 81 along the central longitudinal axis L, without breaking through the leading end 81. The longitudinal blind hole 89 is configured to retain the central portion 93 of the suture 90 within the anchor 80 and to allow the first and second barbed portions 91, 92 of the suture 90 to extend out of the longitudinal blind hole 89 from the trailing  
15 end 82 of the anchor 80

The anchor 80 further comprises a transverse through hole 83 provided in the rigid portion 88 between the trailing end 82 and the closed leading end 81. The transverse through hole 83 is oriented transversely to the longitudinal blind hole 89 and the central longitudinal axis L, and  
20 intersects the longitudinal blind hole 89 at a distance from an inner surface 85 of the leading end 81 of the anchor 80, i.e., the end 85 of the longitudinal blind hole 89. The transverse through hole 83 extends through at least one wall of the rigid portion 88 into the longitudinal blind hole 89, and preferably extends through walls of the rigid portion 88 on opposite sides of the longitudinal blind hole 89 as shown in section B-B of Fig. 3.

25 The anchor 80 also comprises a retaining pin 38 configured to be inserted into the transverse through hole 83 to engage the rigid portion 88, preferably with a locational clearance or transition fit, as the retaining pin 38 is not intended to move relative to the rigid portion 88 once the retaining pin 38 has been inserted into the transverse through hole 83 and engages the rigid  
30 portion 88. Where the transverse through hole 83 extends through walls of the rigid portion 99 on opposite sides of the longitudinal blind hole 89, the retaining pin 38 should have sufficient length to engage the rigid portion 88 of the anchor at both ends of the transverse through hole 83 in the rigid portion 88. In one embodiment, the retaining pin 38 may have a cuboid form with chamfered edges to fit the transverse through hole 83 having a cross-section that is elongated  
35 in the longitudinal direction of the anchor 80, as shown in FIG. 3. An elongate cross-section of the transverse through hole 83 and the retaining pin 38 prevents rotational movement of the retaining pin 38 in the transverse through hole 83. Alternatively, the retaining pin 38 and the

transverse through hole 83 may have any other appropriate matching cross-sectional shape and size as may be desirable.

When the retaining pin 38 has been inserted into the transverse through hole 83 to engage the rigid portion 88, a generally U-shaped suture retaining space 30 is defined around the retaining pin 38 in the longitudinal blind hole 89, adjacent the inner surface 85 of the leading end 81. Depending on the cross-sectional shapes of the retaining pin 38 and the longitudinal blind hole 89, the suture retaining space 30 may have straight or curved surfaces, or a combination of both. The suture retaining space 30 is configured to accommodate the central portion 93 of the suture 90 therein. When the suture 90 has been assembled with the anchor 80, as shown in Fig. 4(c), the central portion 93 of the suture 90 is bent 180° and held in the suture retaining space 30 around the retaining pin 38 in the longitudinal blind hole 89, so that no part of the suture 90 projects beyond the closed leading end 81 of the anchor 80, and the first barbed portion 91 and the second barbed portion 92 of the suture 90 lie parallel to each other. The first barbed portion 91 and the second barbed portion 92 of the suture 90 extend out of the trailing end 82 of the anchor 80 on different sides of the retaining pin 38 that prevents the suture 90 from falling out or being pulled out of the longitudinal blind hole 83.

Preferably, the retaining pin 38 (when assembled with the rigid portion 88 of the anchor 80 and the suture 90) is sized to apply pressure on the central portion 93 of the suture 90 in the suture retaining space 30 around the retaining pin 38 in the longitudinal blind hole 83. Such pressure creates friction between the suture 90 and the inner surface 86 of the rigid portion 88 around the longitudinal blind hole 89 to prevent movement (e.g. rotation or sliding) of the suture 90 in the longitudinal blind hole 89 relative to the anchor 80, thereby forming a secure attachment of the suture 90 to the anchor 80.

Because no part of the of the suture 90 projects beyond the closed leading end 81 of the anchor 80, the practitioner can achieve better precision during implantation of all embodiments of the suture assembly 100 of the present invention in a patient as no spatial allowance needs to be estimated by the practitioner to accommodate extraneous suture that, in other systems, project beyond the leading end 81 of the anchor 80. Such extraneous suture in other systems may comprise one or more knots or as a knot with free ends of the suture extending further beyond the knot. In the present suture assembly 100, certainty of location of the extreme top end of the suture assembly 100 can be determined by feeling for the anchor 80 under the skin since no part of the suture assembly 100 extends beyond the anchor 80 at the implantation site 112.

Furthermore, the present suture assembly 100 does not have any knot of suture that comprises a significantly larger mass of material than the rest of the suture 90. Thus, more uniform biodegradation of the suture 90 of the present suture assembly 100 can be expected when compared to other systems that use one or more knots in their sutures.

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To assemble the suture 90 with the anchor 80, as shown in Fig. 4(a), the central portion 93 of the suture 90 is initially positioned across the trailing end 82 over the longitudinal blind hole 89 of the rigid portion 88 of the anchor 80. The longitudinal axis of the suture 90 should be positioned transversely to the axis of the transverse through hole 83 at this initial assembly position. The central portion 93 of the suture 90 is then pushed into the longitudinal blind hole 89 using an assembly rod 200 until the central portion 93 of the suture 90 contacts the end 85 of the longitudinal blind hole 89 and can go no further, as shown in Fig. 4(b). Positioning the suture 90 transversely to the transverse through hole 83 during assembly ensures that the transverse through hole 83 is not obstructed by the suture 90 when the central portion 93 of the suture 90 is in the longitudinal blind hole 89.

As shown in Fig. 4(c), the assembly rod 200 is subsequently withdrawn from the longitudinal blind hole 89, leaving the central portion 93 of the suture 90 in the longitudinal blind hole 89. This is followed by inserting the retaining pin 38 into the transverse through hole 83 between two halves of the central portion 93 of the suture 90, thereby locking the central portion 93 of the suture 90 within the anchor 80 around the retaining pin 38, thus forming the suture assembly 100 as shown in Fig. 4(d).

Notably, during assembly, as no knot needs to be tied on the suture 90, minimal handling of the suture 90 by the hands of the assembly operator is required compared to other systems where the assembly operator needs to manipulate their sutures to tie one or more knots on their sutures. Minimizing operator handling and manipulating of the suture 90 is advantageous in preserving the formation of and avoiding damage to the barbs 911, 922 on the suture 90 that are needed to engage facial tissue of the patient in order to effect lift when the suture assembly 100 is implanted in the patient.

Besides the rigid portion 88, for all embodiments, the anchor 80 may optionally comprise at least two resilient portions 84 projecting laterally from the rigid portion 88, as shown in FIGS. 3 to 4(c). The at least two resilient portions 84 are configured to be displaceable towards the central longitudinal axis L of the anchor 80 to result in the anchor 80 being in the compressed state. In the compressed state, the greatest lateral diameter or width of the anchor 80 is within the diameter of the entry site of the suture assembly 100, so that the compressed state allows

passage of the anchor 80 through a cannula (not shown) that provides the entry site during implantation of the anchor 80 in the patient. During implantation, upon the anchor 80 exiting the cannula, the at least two resilient portions 84 spring back to their undisplaced positions so that the anchor 80 is again in the free state. In the free state, the at least two resilient portions 84 are  
5 configured to engage facial tissue of a patient to enhance inhibition of downward movement of the anchor 80 when the anchor 80 is implanted in the final implantation position 112 in the patient, thereby providing better grip of facial tissue compared to anchors without the resilient portions.

10 In one embodiment, the at least two resilient portions 84 are symmetrically provided about the central longitudinal axis L of the anchor 80. Preferably, the at least two resilient portions are provided at the trailing end 82 of the rigid portion 88. In other embodiments, the at least two resilient portions may alternatively be provided at the leading end 81 of the rigid portion 88.

15 For all embodiments, the anchor 80 is preferably moulded from a biodegradable material. This means that the anchor 80 will biodegrade over time so that the anchor 80 does not stay implanted permanently. This also reduces the risk of complications. In use, the anchor 80 will stay inside the tissue and dissolve at an equal or lower rate than the suture 90, ensuring the reliability of the lift over the lifetime of the suture assembly 100.

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Whilst there have been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the present invention.

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1. An anchor for a suture assembly for engaging facial tissue, the anchor comprising:
  - a rigid portion having a closed leading end;
  - 5 a longitudinal blind hole formed in the rigid portion from a trailing end of the rigid portion towards the closed leading end;
  - a transverse through hole formed in the rigid portion, the transverse through hole intersecting the longitudinal blind hole at a distance from an inner surface of the leading end; and
  - 10 a retaining pin configured to be inserted into the transverse through hole to engage the rigid portion such that movement of the retaining pin is prevented relative to the rigid portion upon insertion of the retaining pin into the transverse through hole;
  - wherein a suture retaining space is defined around the retaining pin in the longitudinal
  - 15 blind hole when the retaining pin is inserted into the transverse through hole and engages the rigid portion, the suture retaining space configured to retain a central portion of a length of suture therein and to allow free ends of the length of suture to extend out of the longitudinal blind hole from the trailing end of the rigid portion and wherein, the retaining pin is sized such that when the retaining pin is inserted
  - 20 into the transverse through hole, the retaining pin applies pressure on the central portion of the suture in the suture retaining space, thereby preventing movement of the suture in the longitudinal blind hole relative to the anchor.
2. The anchor of claim 1, wherein the transverse through hole has a cross-section
- 25 elongated in a longitudinal direction of the anchor.
3. The anchor of claim 2, wherein the retaining pin has a cuboidal form.
4. The anchor of any one of the preceding claims, wherein the retaining pin engages the
- 30 rigid portion with one of: a locational clearance fit and a locational transition fit.
5. The anchor of any one of the preceding claims, wherein the transverse through hole extends through walls of the rigid portion on opposite sides of the longitudinal blind hole.
- 35 6. The anchor of claim 5, wherein the retaining pin has a length sufficient to engage the rigid portion at both ends of the transverse through hole in the rigid portion.

7. The anchor of any one of the preceding claims, wherein the anchor further comprises at least two resilient portions projecting laterally from the rigid portion, the at least two resilient portions configured to be displaceable towards a central longitudinal axis of the anchor to allow passage of the anchor through a cannula during implantation of the suture assembly in a patient, the at least two resilient portions further configured to return to their undisplaced positions once the anchor exits the cannula in order to engage facial tissue of the patient to resist movement of the anchor after the anchor is implanted in the patient.

8. A suture assembly for engaging facial tissue, the suture assembly comprising:  
the anchor of any one of the preceding claims; and  
a suture, the suture comprising:

a single length of suture having two free ends;

a central portion between the two free ends;

a first barbed portion on one side of the central portion, the first barbed portion having a first plurality of barbs formed thereon; and

a second barbed portion on another side of the central portion, the second barbed portion having a second plurality of barbs formed thereon,

wherein the first plurality of barbs and the second plurality of barbs are inclined towards the central portion,

wherein the central portion of the suture is in the longitudinal blind hole and retained in the suture retaining space by the retaining pin inserted into the transverse through hole to engage the rigid portion, the retaining pin applying a pressure on the central portion of the suture in the suture retaining space to create friction between the suture and an inner surface of the rigid portion around the suture retaining space to prevent movement of the suture in the longitudinal blind hole relative to the anchor, and wherein the first barbed portion and the second barbed portion extend out of the longitudinal blind hole from the trailing end of the rigid portion.