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(54) FOLDED MESH FOR REPAIR OF MUSCLE WALL DEFECT
GEFALTetes NETZ Zur REPARatur VON MUSKELWandDEFekten
TREILLIS REPLIÉ POUR RÉPARATION DE DÉFAUT DANS LA PARoi MUSCULAIRe

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The invention relates to a surgical implant adapted for repairing a tissue or muscle wall defect, in particular for repairing an inguinal hernia, and to a method of manufacturing such implant.

The repair of inguinal hernias is one of the most commonly performed surgical procedures. Various prosthetic materials, typically porous to allow for tissue ingrowth, have been provided in a variety of combinations, forms and shapes. The repair of inguinal hernias is often achieved by implanting a mesh plug into the hernia defect. Various materials have been discussed for use as prosthetic plugs. Polypropylene is most often used in the form of a knitted mesh fabric to create the desired shapes.

Many of the commercially available plugs comprise an outer shell (usually made of mesh material) with a separate "filler" material attached to the inside of the outer shell. The filler serves as a means to grasp and position the plug during a surgical procedure. Moreover, the filler, in conjunction with the outer shell, enables tissue in-growth to occur over time.

EP 0 614 650 A2 discloses an implantable prosthesis for muscle or tissue wall repairs comprising a mesh of knitted polypropylene monofilaments. An outer shell made from the mesh material is cone-like (and fluted). Moreover, multiple inner layers of mesh material are provided, which are located in the outer shell and attached in the tip area of the cone configuration. A similar implant is known from WO 97/45068 A1.

CN 101112335 A describes an embeddable multipurpose external hernia-remedying slice comprising a substrate and a plurality of petals arranged on the upper surface of the substrate. The distal ends of the petals are free, whereas the proximal ends are fixed to the center of the substrate. A plurality of reinforcement ribs can be arranged on the upper surface of the substrate.

EP 0 888 756 A2 discloses a surgical implant for hernioplasty made of polypropylene mesh material, in which an areal base and a protrusion serving as a plug are joined by stitches.

US 6,616,685 B shows an implant for repairing a tissue or muscle wall defect which includes a first composite structure including at least one layer of a non-absorbable material, a second structure having a reinforced central region, a reinforcing element positioned between the first and second structures, and at least one pulling element coupled to the reinforced central region of the second structure.

US 5,249,682 concerns a package for holding prosthetic plugs. Polypropylene is most often used in the form of a knitted mesh fabric to create the desired shapes.

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The invention relates to a surgical implant adapted for repairing a tissue or muscle wall defect, in particular for repairing an inguinal hernia, and to a method of manufacturing such implant. This object is achieved by a surgical implant comprising an areal, flexible basic structure which defines a primary region and at least one arm starting from the primary region and having a free end and an end area extending up to the free end. The arm is folded back and fixed, in its end area, to the primary region of the basic structure.

In advantageous embodiments of the invention, a plurality of arms starts from the primary region. In this way, the primary region is generally located in the center area of the basic structure, and the arms form a kind of three-dimensional filler. The arms can have different lengths. It is also possible that at least one additional arm starts from the primary region and is not fixed to the primary region. The implant can be rotationally symmetric with respect to rotations by an angle $\alpha$ about an axis running transversely through the primary region, wherein $n \cdot \alpha = 360^\circ$ and $n \geq 2$. Preferably, this axis of rotation is running perpendicularly with respect to a plane generally aligned in parallel to the primary region of the basic structure.

Generally, the implant according to the invention can be optimized in size and shape, depending on the application in question. The end areas of the arms, after folding back, can be easily fixed to the primary region of the basic structure, e.g. by welding, suturing and/or gluing, e.g. in a center area, in a peripheral area or in an intermediate area between the center area and the peripheral area of the primary region. It is possible to fix different arms at different distances from the center of the primary region. By varying the size and shape of the primary region, the size, length and shape of the...
In advantageous embodiments of the invention, by a gripping instrument. surgery because the implant can be grasped at such filler by the implant and which facilitates the handling during arms serve as a filler, which fills the defect to be repaired can be designed in many different forms. The folded back arms, the number of arms, or the position where a re-

particular in the ratio 90:10, "Vicryl"), poly-p-dioxanone ble materials are copolymers of glycolide and polypropylene ("Prolene") as well as blends of polyvinyli-

can be designed as mono-filaments or as multi-filaments. Any blends, mixtures or composites of materials and designs are also possible. Moreover, the filaments can be coated.

Examples for non-absorbable materials are polypropylene ("Prolene") as well as blends of polyvinylidenic fluoride and copolymers of vinylidene fluoride and hexafluoropropene ("Pronova"). Examples for absorbable materials are copolymers of glycolide and lactide (in particular in the ratio 90:10, "Vicryl"), poly-p-dioxanone ("PDS"), and copolymers of glycolide and ε-caprolactone ("Monocryl"). The indicated designations are trademarks used by the applicant. Other materials suitable for the use with surgical implants are known in the art as well.

Examples for meshes comprised in the basic structure are "Vypro" and "Vypro II" meshes (containing multifilaments of "Vicryl" and polypropylene), "Ultrapro" meshes (containing monofilaments of "Monocryl" and polypropylene) and soft "Prolene" meshes (containing polypropylene). Again, the indicated designations are trademarks used by the applicant.

As already mentioned, one or more additional layers may be added to the mesh to make it a composite structure. The additional layers may include, e.g. bio-absorbable films, non-absorbable films, and/or oxidized regenered cellulose. By means of a film, e.g., tissue ingrowth can be controlled, and a film can serve as a barrier for adhesion and a means for tissue separation. For example, the mesh of the basic structure can be covered from one or both sides with a polymeric film structure, which is absorbable or permanent and can additionally provide a barrier for adhesion.

Examples for meshes having an additional film layer are "Physiomesh" meshes and "Proceed" meshes; these designations are trademarks used by the applicant. If a "Proceed" mesh comprising one layer of oxidized regenerated cellulose (ORC) is used, the ORC layer should be placed on the outer face of the implant, i.e. that face primarily coming into contact with bodily tissue.

In advantageous embodiments of the invention, the basic structure comprises a mesh. The basic structure can also comprise a composite structure, in which at least one additional layer is added to the mesh, e.g. a film.

The mesh of the basic structure is preferably macro-porous with typical pore dimensions of greater than 0.5 mm, which supports good tissue integration. Other pore sizes are conceivable as well, however. The mesh can be provided in any kind known in the art, e.g., warp-knitted or weft-knitted or crochet-knitted or woven. A design as perforated film or foil is also conceivable. Any filaments of the mesh may be bio-absorbable or non-absorbable, depending on the material. The filaments can be designed as mono-filaments or as multi-filaments. Any blends, mixtures or composites of materials and designs are also possible. Moreover, the filaments can be coated.

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instrument penetrates through the, e.g., macro-porous mesh of the basic structure, which could lead to injuries of surrounding tissue.

Moreover, the reinforcement elements or at least one of the reinforcement elements may be colored. In this way, the visibility of the whole implant in the area of surgery can be enhanced, the implant can be more easily oriented, and the grasping and general handling of the implant can be facilitated. For example, the center area of the implant can be marked by colored reinforcement elements. A suitable dye is, e.g., D&C violet No. 2.

Generally, the surgical implant according to the invention provides many advantages. It can be easily produced at relatively low cost, e.g. as a light-weight structure with low foreign body sensation and causing no or little chronic pain, but nevertheless having sufficient strength. During surgery, the implant requires minimal manipulation of anatomic structures only and, as a rule, no preperitoneal mobilization. Compared to traditional plug techniques (according to Rutkow), little training is required for working with the implant. Implantation tends to be fast and positioning easy. The folded-back arms provide a convenient grasping and handling help for placing and positioning the implant into the defect by means of a surgical instrument, wherein the tip of the instrument tends to be protected from penetrating the implant and causing injury. Generally, the volume of the defect is filled by the implant, which is flexible. Depending on the desired application and the materials used, the implant can be fully or partially bio-degradable.

The surgical implant can be used to repair defects of different sizes. It is possible to fix the implant at the margins of the defect, e.g. by suturing, wherein longer arms (greater loops) can be, in general, handled more easily. Generally, the implant can be used in the pre-peritoneal space as well as in the intra-peritoneal space (abdomen). Other possible uses relate to the repair of ventral hernia defects, umbilical and incisional hernia defects, etc.

Some surgeons prefer to place, after inserting the surgical implant described so far into a hernia defect, a piece of a separate surgical mesh on top of the implant or the bodily tissue in the area of the implant, respectively. To this end, a kit is provided which comprises a surgical implant as described before plus a separate surgical mesh, which is adapted to be placed on top of the tissue or muscle wall defect after the surgical implant has been applied. This separate surgical mesh can be pre-shaped to an appropriate size and/or can be trimmed to the desired size, if required. Preferably, the material of the separate surgical mesh is the same as that of a mesh in the basic structure. The separate surgical mesh can also comprise a composite structure.

In a method of manufacturing a surgical implant according to the invention, a flexible basic structure is provided and the arm or arms are folded back and fixed, in its or their end areas, to the primary region of the basic structure, e.g. by welding, suturing or gluing.

In the following, the invention is described in further detail by means of examples. The drawings show in

Figure 1 in parts (a), (b), (c) and (d) several views of an embodiment of the surgical implant according to the invention, i.e. in part (a) a plan view of a basic structure, in part (b) the basic structure after forming a protrusion in its center area, in part (c) a longitudinal section through the protrusion, and in part (d) a three-dimensional view of the implant after folding the basic structure,

Figure 2 a three-dimensional view of a variant of the embodiment of Figure 1, which comprises reinforcement elements,

Figure 3 a three-dimensional view of another variant of the embodiment of Figure 1, which comprises arms having different lengths,

Figure 4 in parts (a), (b) and (c) several views of another embodiment of the surgical implant according to the invention, i.e. in part (a) a plan view of a basic structure, in part (b) a three-dimensional view of the implant after folding a variant of the basic structure, and in part (c) a three-dimensional view after further forming the implant, and

Figure 5 in parts (a) and (b) views of another embodiment of the surgical implant according to the invention, i.e. in part (a) a plan view of a basic structure and in part (b) a three-dimensional view of the implant after folding the basic structure.

Figure 1 illustrates a first embodiment of a surgical implant, which is designated by reference numeral 1.

In Figure 1(a), a basic structure 2 is shown in plan view. The basic structure 2 comprises a primary region 4 in its center area and a total of eight arms 6 starting from the periphery 8 of the primary region 4. Each arm 6 has a free end 10 and, adjacent to its free 10, an end area 11.

The basic structure 2 is areal, i.e. made of relatively thin material, and flexible. In the embodiment, it comprises a surgical mesh, e.g. a "Vypro II" mesh (see above), which includes multifilaments of "Vicryl" (absorbable) and polypropylene (non-absorbable). Moreover, in the embodiment, the basic structure 2 is made from one piece, e.g. by die-cutting.

Figure 1(b) shows the basic structure 2 after a protrusion 12 has been formed in the center area of the primary region 4. Figure 1(c) displays the protrusion 12 in longitudinal section in a plane perpendicular to the
plane of Figure 1(b) and running through the center of the basic structure 2. In the embodiment, the protrusion 12 has an elliptic curvature and is atraumatic, i.e. it is designed as a low-profile tip. It is formed by thermosetting, which results in a stiffening effect in the center area of the basic structure 2 and stabilizes the primary region 4 of the implant 1. The protrusion 12 facilitates the handling of the implant 1 during surgery, can prevent a tip of a grasping instrument from penetrating the basic structure 2 and causing injury, and minimizes an irritation of the peritoneum.

[0038] Figure 1(d) illustrates how the three-dimensional shape of the implant 1 is formed. To this end, the arms 6 are folded back towards the primary region 4, as indicated by the arrows, and the end areas 11 of the arms 6 are fixed to the primary region, e.g. by ultrasonic welding, suturing or gluing (e.g. using poly-p-dioxanone as a glue). (To be precisely, Figure 1(d) relates to a slight variant of the basic structure 2 of Figures 1(a) and (1b), in which the arms 6 are slightly wider.) The protrusion 12 is not visible in Figure 1(d); it extends to the bottom side, i.e. away from the arms 6.

[0039] Figure 2 shows a variant of the implant 1 of Figure 1, which is designated by 1'. Otherwise, the same reference numerals are used as in Figure 1.

[0040] The implant 1' is reinforced and stiffened by reinforcement elements fixed to the outer face of the basic structure 2 visible in Figure 2. In the embodiment, the reinforcement elements comprise a circular reinforcement band 14, which encircles the protrusion 12, and radial reinforcement bands 16 extending along part of each arm 6. They are cut from a one-piece blank of poly-p-dioxanone and welded to the basic structure before the arms 6 are folded. An increased stiffness of the implant facilitates its placement during surgery. Poly-p-dioxanone is absorbable so that, after some time, the stiffness imposed by the reinforcement elements disappears. The reinforcement elements can be colored in order to enhance the visibility of the implant during surgery.

[0041] Figure 3 shows another variant of the implant 1 of Figure 1, which is designated by 1". Otherwise, the same reference numerals are used as in Figure 1.

[0042] In the implant 1", each second arm 6" is longer than the other arms 6, so that after back-folding the arms and attaching their end areas to the primary region 4, the loops formed by the arms 6" are greater than the loops formed by the arms 6. When, during surgery, the implant 1" is to be fixed to bodily tissue by suturing, the loops of the arms 6" can be preferably used for taking up the sutures.

[0043] In the finished implants 1, 1' and 1", as shown in Figures 1(d), 2 and 3, the arms 6 and 6' form loops and together act as a plug which can be easily grasped in a surgical procedure and inserted into the defect to be repaired.

[0044] Another embodiment of a surgical implant, designated by 20, is illustrated in Figure 4.

[0045] Figure 4(a) is a plan view of its basic structure 22, which is cut in one piece from mesh material. The basic structure 22 defines a primary region 24 and a total of five arms 26, which are separated by cut lines 27. Since the basic structure is circular and the arms 27 are only separated by the cut lines 27, the free ends 28 of the arms 27 are defined by the circumference line of the circle. After folding back, however, each arm is attached to the primary region 24 in a small peripheral area 29 only.

[0046] Figure 4(b) shows the result for the form of the implant after folding back the arms and attachment to the primary region. The implant of Figure 4 (b) is a variant of the implant 20 and designated by 20', because it comprises only four arms 26' instead of five. Moreover, the curvature of the cut lines between the arms 26' is mirror-like compared to the curvature of the cut lines 27 in Figure 4 (a). The arms 26' can be rolled somewhat about the inner parts of the implant 20', which results in the appearance shown in Figure 4(c).

[0047] Figure 5 displays another embodiment of the surgical implant, here designated by 30.

[0048] The implant 30 comprises a circular basic structure 32, see Figure 5(a). Its primary region 34 is reinforced by a circular reinforcement band 35 consisting, in the embodiment, of poly-p-dioxanone. Three arms 36 are separated by curved cut lines 37. In the inner parts of the cut lines 37, the arms are stiffened by radial reinforcement bands 38, which are penetrated by the cut lines 37.

[0049] Starting from the state shown in Figure 5(a), the arms 36 are folded back towards the primary region 34 and are fixed, by means of end areas 39, to the primary region 34. To this end, the poly-p-dioxanone material of the circular reinforcement band 35 is used as a melt-glue.

[0050] Figure 5(b) shows the three-dimensional shape of the implant 30. As with the other implants, the loops formed by the arms can be pressed together when the implant is inserted in a hernia defect.

[0051] Many examples for suitable materials and compositions of the basic structure, including composite structures, have already been presented further above.

Claims

1. Surgical implant adapted for repairing a tissue or muscle wall defect, comprising an areal, flexible basic structure (2; 22; 32) comprising a mesh which defines a primary region (4; 24; 34) and at least one arm (6; 6"; 26; 26' 36) starting from the primary region (4; 24; 34) and having a free end (10; 28) and an end area (11; 29; 39) extending up to the free end (10; 28), characterized in that the arm (6; 6"; 26; 26'; 36) is folded back and fixed, in its end area (11; 29; 39), to the primary region (4; 24; 34) of the basic structure (2; 22; 32) to form a looped three-dimensional structure for filling a tissue or muscle wall defect to be repaired by the implant.

2. Surgical implant according to claim 1, characterized
4. Surgical implant according to claim 2, characterized in that a plurality of arms (6; 6"; 26; 26'; 36) starts from the primary region (4; 24; 34).

3. Surgical implant according to claim 2, characterized in that at least two arms (6, 6") have a different length.

4. Surgical implant according to claim 2 or 3, characterized in that the implant (1; 1'; 1"; 20; 20'; 30) is rotationally symmetric with respect to rotations by an angle $\alpha$ about an axis running transversely through the primary region (4; 24; 34), wherein $n\alpha = 360^\circ$ and $n \geq 2$.

5. Surgical implant according to claim 1, characterized in that the mesh comprises at least one of the properties included in the following list: being macro-porous, comprising a warp-knit, comprising a weft-knit, comprising a crochet-knit, comprising a woven fabric, comprising a perforated film, comprising bio-absorbable filaments, comprising non-absorbable filaments, comprising mono-filaments, comprising multi-filaments, comprising tape yarns, comprising drawn film tapes.

6. Surgical implant according to claim 1 or 5, characterized in that the mesh comprises at least one of the materials selected from the following list: polypropylene, poly-p-dioxanone, copolymers of glycolide and lactide, copolymers of glycolide and lactide in the ratio 90:10, copolymers of glycolide and $\varepsilon$-caprolactone, blends of polyvinylidene fluoride and $\varepsilon$-caprolactone, formed as a dome-like protrusion (12), preferably wherein the at least one additional layer comprises a film, formed as a strip, formed as a rib, arranged concentrically with respect to a center of the primary region (4; 34), arranged radially with respect to a center of the primary region (4; 34), laminated to the basic structure (2; 32), preferably wherein the at least one reinforcement element (14, 16; 35, 38) attached to the basic structure (2; 32), preferably wherein the at least one reinforcement element (14, 16; 35, 38) comprises at least one of the properties included in the following list: made as a film, formed as a strip, formed as a rib, arranged concentrically with respect to a center of the primary region (4; 34), arranged radially with respect to a center of the primary region (4; 34), laminated to the basic structure (2; 32), being absorbable, made from poly-p-dioxanone, made from a copolymer of glycolide and $\varepsilon$-caprolactone, colored.

7. Surgical implant according to anyone of claims 1 to 11, characterized in that the basic structure (2; 22; 32) comprises a composite structure, in which at least one additional layer is added to the mesh, preferably wherein the at least one additional layer comprises a film, wherein the film comprises at least one of the properties included in the following list: being bio-absorbable, being non-absorbable, comprising oxidized regenerated cellulose.

8. Surgical implant according to anyone of claims 1 to 7, characterized in that the basic structure (2; 22; 32) is made from one piece.

9. Surgical implant according to anyone of claims 1 to 8, characterized in that the primary region (4) of the basic structure (2) comprises a permanent curvature (12), preferably wherein the curvature is formed as a dome-like protrusion (12).

10. Surgical implant according to claim 9, characterized in that at least one of the following properties: being thermo-formed, having a curved or flattened longitudinal profile, being located in the center area of the primary region.

11. Surgical implant according to anyone of claims 1 to 10, characterized in that the at least one arm (6; 6"; 26; 26'; 36), in its end area (11; 29; 39), is fixed to the primary region (4; 24; 34) in one of the areas of the primary region (4; 24; 34) and in one of the ways included in the following list: welded in center area, welded in peripheral area, welded in intermediate area between center area and peripheral area, sutured in center area, sutured in peripheral area, sutured in intermediate area between center area and peripheral area, glued in center area, glued in peripheral area, glued in intermediate area between center area and peripheral area.

12. Surgical implant according to anyone of claims 1 to 11, characterized by at least one reinforcement element (14, 16; 35, 38) attached to the basic structure (2; 32), preferably wherein the at least one reinforcement element (14, 16; 35, 38) comprises at least one of the properties included in the following list: made as a film, formed as a strip, formed as a rib, arranged concentrically with respect to a center of the primary region (4; 34), arranged radially with respect to a center of the primary region (4; 34), laminated to the basic structure (2; 32), being absorbable, made from poly-p-dioxanone, made from a copolymer of glycolide and $\varepsilon$-caprolactone, colored.

13. Surgical implant according to anyone of claims 1 to 12, characterized by at least one additional arm starting from the primary region which is not fixed to the primary region.

14. Kit, comprising a surgical implant according to anyone of claims 1 to 13 and a separate surgical mesh adapted to be placed on top of the tissue or muscle wall defect after the surgical implant (1; 1'; 1"; 20; 20'; 30) has been applied.

15. Method of manufacturing a surgical implant having the features of claim 1, characterized by providing a flexible basic structure (2; 22; 32) comprising a mesh which defines a primary region (4; 24; 34) and at least one arm (6; 6"; 26; 26'; 36) starting from the primary region (4; 24; 34) and having a free end (10; 28) and an end area (11; 29; 39) extending up to the free end (10; 28), and folding the at least one arm (6; 6"; 26; 26'; 36) back and fixing it, in its end area (11; 29; 39), to the primary region (4; 24; 34) of the basic structure (2; 22; 32) to form a looped three dimensional structure.
Chirurgisches Implantat, das zur Reparatur eines Gewebe- oder Muskelwanddefekts ausgelegt ist, umfassend eine flächige flexible Grundstruktur (2; 22; 32), die ein Netz, das eine Primärregion (4; 24; 34) definiert, und mindestens einen Arm (6; 6"; 26; 26'; 36) umfasst, der bei der Primärregion (4; 24; 34) beginnt und ein freies Ende (10; 28) und einen sich bis zum freien Ende (10; 28) erstreckenden Endbereich (11; 29; 39) aufweist, dadurch gekennzeichnet, dass der Arm (6; 6"; 26; 26'; 36) in seinem Endbereich (11; 29; 39) auf die Primärregion (4; 24; 34) begibt.

2. Chirurgisches Implantat nach Anspruch 1, dadurch gekennzeichnet, dass eine Vielzahl von Armen (6; 6"; 26; 26'; 36) bei der Primärregion (4; 24; 34) beginnt.

3. Chirurgisches Implantat nach Anspruch 2, dadurch gekennzeichnet, dass mindestens zwei Arme (6, 6") eine unterschiedliche Länge aufweisen.

4. Chirurgisches Implantat nach Anspruch 2 oder 3, dadurch gekennzeichnet, dass das Implantat (1; 1"; 1'; 20; 20'; 30) rotationssymmetrisch bezüglich Drehungen um einen Winkel α um eine quer durch die Primärregion (4; 24; 34) verlaufende Achse ist, wobei n·α = 360° und n ≥ 2.


7. Chirurgisches Implantat nach einem der Ansprüche 1, 5 oder 6, dadurch gekennzeichnet, dass die Grundstruktur (2; 22; 32) eine Verbundstruktur umfasst, in der dem Netz mindestens eine zusätzliche Schicht hinzugefügt wird, wobei vorzugsweise die mindestens eine zusätzliche Schicht eine Folie umfasst, wobei die Folie mindestens eine der in der folgenden Liste enthaltenen Eigenschaften umfasst: sie ist bioresorbierbar, sie ist nichtresorbierbar, sie umfasst oxidierte regenerierte Cellulose.

8. Chirurgisches Implantat nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, dass die Grundstruktur (2; 22; 32) aus einem Stück gefertigt ist.

9. Chirurgisches Implantat nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, dass die Primärregion (4) der Grundstruktur (2) eine permanente Krümmung (12) umfasst, wobei die Krümmung vorzugsweise als kuppelförmiger Vorsprung (12) ausgebildet ist.

10. Chirurgisches Implantat nach Anspruch 9, dadurch gekennzeichnet, dass der kuppelförmige Vorsprung (12) mindestens eine der folgenden Eigenschaften umfasst: er ist thermogemäß, er hat ein gebogenes oder abgeflachtes Längsprofil, er ist im mittleren Bereich der Primärregion angeordnet.

11. Chirurgisches Implantat nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, dass der mindestens eine Arm (6; 6"; 26; 26'; 36) in seinem Endbereich (11; 29; 39) an der Primärregion (4) (24; 34) in einem der Bereiche der Primärregion (4; 24; 34) und auf einer der in der folgenden Liste enthaltenen Arten fixiert ist: angeschweißt im mittleren Bereich, angeschweißt im Zwischenbereich zwischen dem mittleren Bereich und dem Umfangsbereich, festgenäht im mittleren Bereich, festgenäht im Zwischenbereich zwischen dem mittleren Bereich und dem Umfangsbereich, angeklebt im mittleren Bereich, angeklebt im Zwischenbereich zwischen dem mittleren Bereich und dem Umfangsbereich.

12. Chirurgisches Implantat nach einem der Ansprüche 1 bis 11, gekennzeichnet durch mindestens ein Verstärkungselement (14, 16; 35, 38), das an der Grundstruktur (2) festgebastet ist, wobei vorzugsweise das mindestens eine Verstärkungselement (14, 16; 35, 38) mindestens eine der in der folgenden Liste enthaltenen Eigenschaften umfasst: es ist als Folie geformt, es ist als Streifen geformt, es ist als Rippe geformt, es ist konzentrisch bezüglich einer Mitte der Primärregion (4; 34) angeordnet, es ist radial bezüglich einer Mitte der Primärregion (4; 34) angeordnet, es ist auf die Grundstruktur (2; 32) laminiert, es ist resorbierbar, es besteht aus Poly-p-
13. Implant chirurgical apte à réparer un défaut dans un tissu ou une paroi musculaire, comprenant une structure de base, intéressant une zone primaire et au moins un bras partant de la zone primaire et comportant une extrémité libre et une zone terminale, caractérisé en ce que l’implant (1 ; 1’ ; 1” ; 20 ; 20’ ; 30) présente une symétrie de révolution par rapport à des rotations d’un angle α autour d’un axe traversant transversalement la zone primaire (4 ; 24 ; 34), où n = α = 360° et n ≥ 2.

5. Implant chirurgical selon la revendication 1, caractérisé en ce que le tissu à mailles comprend au moins une des propriétés incluses dans la liste suivante : être macroporeux, comprendre un tricot chaîne, comprendre un tricot trame, comprendre un tricot au crochet, comprendre un tissu tissé, comprendre un film perforé, comprendre des filaments biorésorbables, comprendre des filaments non-résorbables, comprendre des mono-filaments, comprendre des multi-filaments, comprendre des fils de bandelette, comprendre des bandelettes de film étiéré.

10. Kit, comprenant un implant chirurgical selon l’une quelconque des revendications 1 à 7, caractérisé en ce que l’implant (1 ; 1’ ; 1” ; 20 ; 20’ ; 30) est multiplié par un factor n, avec n ≥ 2.

15. Verfahren zur Herstellung eines chirurgischen Implantats mit den Merkmalen von Anspruch 1, gekennzeichnet durch die Bereitstellung einer flächigen flexiblen Grundstruktur (2 ; 22 ; 32), die ein Netz, das eine Primärregion (4 ; 24 ; 34) definierend, und mindestens einen Arm (6 ; 6” ; 26 ; 26’ ; 36) umfasst, der bei der Primärregion (4 ; 24 ; 34) beginnt und ein freies Ende (10 ; 28) und einen sich bis zum freien Ende (10 ; 28) erstreckenden Endbereich (11 ; 29 ; 39) aufweist, und Umfalten des mindestens einen Arms (6 ; 6” ; 26 ; 26’ ; 36) und Fixierung in seinem Endbereich (11 ; 29 ; 39) auf der Primärregion (4 ; 24 ; 34) der Grundstruktur (2 ; 22 ; 32) zur Bildung einer schleifenförmigen dreidimensionalen Struktur.

20. Implant chirurgical selon la revendication 1 ou 5, caractérisé en ce que le tissu à mailles comprend au moins une des matières choisies dans la liste suivante : polypropylène, poly(p-dioxanone), copolymères de glycolide et lactide, copolymères de glycolide et lactide dans le rapport 90:10, copolymères de glycolide et α-caprolacton, mélanges de polyfluorure de vinylidène et copolymères de fluorure de vinylidène et hexafluoro-propène.

25. Implant chirurgical selon l’une quelconque des revendications 1, 5 ou 6, caractérisé en ce que la structure de base (2 ; 22 ; 32) comprend une structure composite, dans laquelle au moins une couche supplémentaire est ajouté au tissu à mailles, de préférence dans lequel ladite couche supplémentaire comprend un film, dans lequel le film comprend au moins une des propriétés incluses dans la liste suivante : être biorésorbable, être non-résorbable, comprendre de la cellulose régénérée oxydée.

30. Implant chirurgical selon l’une quelconque des revendications 1 à 7, caractérisé en ce que la structure de base (2 ; 22 ; 32) est faite d’une seule pièce.

35. Implant chirurgical selon l’une quelconque des revendications 1 à 8, caractérisé en ce que la zone primaire (4) de la structure de base (2) comprend une courbure (12) permanente, de préférence dans lequel la courbure est formée comme une bosse (12) en forme de dôme.

40. Implant chirurgical selon l’une quelconque des revendications 1 à 8, caractérisé en ce que la zone primaire (4) de la structure de base (2) comprend une courbure (12) permanente, de préférence dans lequel la courbure est formée comme une bosse (12) en forme de dôme.

45. Implant chirurgical selon l’une quelconque des revendications 1 à 8, caractérisé en ce que la zone primaire (4) de la structure de base (2) comprend une courbure (12) permanente, de préférence dans lequel la courbure est formée comme une bosse (12) en forme de dôme.

50. Implant chirurgical selon la revendication 1, caractérisé en ce qu’une pluralité de bras (6 ; 6” ; 26 ; 26’ ; 36) partent de la zone primaire (4 ; 24 ; 34).

55. Implant chirurgical selon la revendication 2, caractérisé en ce que au moins deux bras (6, 6”) ont une longueur différente.

60. Implant chirurgical selon la revendication 2 ou 3, caractérisé en ce que l’implant (1 ; 1’ ; 1” ; 20 ; 20’ ; 30) présente une symétrie de révolution par rapport à des rotations d’un angle α autour d’un axe traversant transversalement la zone primaire (4 ; 24 ; 34), où n = α = 360° et n ≥ 2.
11. Implant chirurgical selon l’une quelconque des revendications 1 à 10, caractérisé en ce que ledit bras (6 ; 6" ; 26 ; 26’ ; 36), dans sa zone terminale (11 ; 29 ; 39), est fixé à la zone primaire (4 ; 24 ; 34) dans l’une des zones de la zone primaire (4 ; 24 ; 34) et selon l’une des façons incluses dans la liste suivante : soudé dans la zone centrale, soudé dans la zone périphérique, soudé dans une zone intermédiaire entre la zone centrale et la zone périphérique, suturé dans la zone centrale, suturé dans la zone périphérique, suturé dans une zone intermédiaire entre la zone centrale et la zone périphérique, collé dans la zone centrale, collé dans la zone périphérique, collé dans une zone intermédiaire entre la zone centrale et la zone périphérique.

12. Implant chirurgical selon l’une quelconque des revendications 1 à 11, caractérisé par au moins un élément de renfort (14, 16 ; 35, 38) fixé à la structure de base (2 ; 32), de préférence dans lequel ledit élément de renfort (14, 16 ; 35, 38) comprend au moins une des propriétés incluses dans la liste suivante : fait comme un film, formé comme une bande, formé comme une nervure, disposé concentriquement par rapport au centre de la zone primaire (4 ; 34), disposé radialement par rapport au centre de la zone primaire (4 ; 34), contre-plaqué sur la structure de base (2 ; 32), être résorbable, fait de poly(p-dioxanone), fait d’un copolymère de glycolide et ε-caprolactone, coloré.

13. Implant chirurgical selon l’une quelconque des revendications 1 à 12, caractérisé par au moins un bras supplémentaire partant de la zone primaire qui n’est pas fixé à la zone primaire.

14. Kit, comprenant un implant chirurgical selon l’une quelconque des revendications 1 à 13 et un tissu à mailles chirurgical séparé apte à être placé sur le défaut dans un tissu ou une paroi musculaire après que l’implant chirurgical (1 ; 1’ ; 1” ; 20 ; 20’ ; 30) a été appliqué.

15. Procédé de fabrication d’un implant chirurgical présentant les caractéristiques de la revendication 1, caractérisé par les opérations consistant à se procurer une structure de base (2 ; 22 ; 32) souple qui comprend un tissu à mailles définissant une zone primaire (4 ; 24 ; 34) et au moins un bras (6 ; 6" ; 26 ; 26’ ; 36) partant de la zone primaire (4 ; 24 ; 34) et comportant une extrémité libre (10 ; 28) et une zone terminale (11 ; 29 ; 39) s’étendant jusqu’à l’extrémité libre (10 ; 28), et replier ledit bras (6 ; 6” ; 26 ; 26’ ; 36) et le fixer, dans sa zone terminale (11 ; 29 ; 39), à la zone primaire (4 ; 24 ; 34) de la structure de base (2 ; 22 ; 32) pour constituer une structure tridimensionnelle en boucle.
REFERENCES CITED IN THE DESCRIPTION

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