resulting in the aforementioned closure-induced scarring that can occur with the prior art techniques. Furthermore, in certain embodiments the wound closure devices disclosed herein may be appropriately secured to a wound without the need for adhesive, thus avoiding potential allergic complications.

SUMMARY

In one aspect, there is provided a wound closure device comprising two or more microstructure arrays, each microstructure array comprising at least two microstructures, wherein the at least two or more microstructure arrays are attached to a flexible backing.

The present ~~invention~~ disclosure relates generally to wound closure devices comprising one or more microstructures. In some ~~embodiments~~examples, the microstructures are capable of penetrating into skin or tissue. In some ~~embodiments~~examples, the device comprises a plurality of microstructures. The microstructures are fabricated on, affixed to, or connected to a base or backing that may optionally be made out of the same material as the microstructures, or a different material. In some ~~embodiments~~examples, the base or backing is flexible, stretchable, or both flexible and stretchable. In some ~~embodiments~~examples, the microstructures are fashioned into one or more microstructure arrays, upon a base. In particular ~~embodiments~~examples, the wound closure devices comprise at least two microstructure arrays, each array being patterned upon a base (said base optionally comprising one or more arrays), and said arrays optionally being affixed to a backing, according to the present disclosure. In such ~~embodiments~~examples, at least one of said arrays is capable of securing the device on one side of a wound, and at least one other of said arrays is capable of securing the device on another side of the wound. In other particular ~~embodiments~~examples, the wound closure devices comprise only one microstructure array, said array fabricated on a base portion, and said base portion optionally being affixed to a backing. In such ~~embodiments~~examples, at least one of the microstructures comprised in the array is capable of securing the device on one side of the wound and at least one other microstructure comprised on the array is capable of securing the device on the other side of the wound.

Devices of the present ~~invention~~disclosure are useful wound closure products, capable of performing a variety functions (*e.g.*, protecting a wound from its surrounding environment, preventing infection, closing a wound, and increasing the delivery of therapeutic compounds through skin).

In particular ~~embodiments~~examples, the devices are specifically designed such that their application does not result in inflammation. In some ~~embodiments~~examples, the wound closure devices disclosed herein induce little to no inflammation and result in little to no additional scarring (*e.g.*, the railroad track effect that results from staples and sutures). In

some ~~embodiments~~examples, the devices of the present ~~invention~~disclosure have the important advantage of being easily applied and removed without the need for extensive training or specialized equipment. Furthermore, in certain ~~embodiments~~examples, the devices are secured to the skin of a patient in the absence of an adhesive, avoiding allergic reactions caused by adhesives. Thus, the wound closure devices of the present ~~invention~~disclosure provide an attractive and versatile alternative to traditional wound closure devices.

In some ~~embodiments~~examples, the wound closure devices of the present ~~invention~~disclosure comprise a flexible and/or stretchable backing upon which one or more microstructures are affixed. In some ~~embodiments~~examples, one or more microstructure arrays are affixed to a flexible and/or stretchable backing. The flexibility and/or stretchability of the backing may be uniform throughout; or, optionally one or both of these properties may vary across, or along, the device, a microstructure array, or between two or more microstructure arrays.

In some ~~embodiments~~examples, the wound closure device of the present ~~invention~~disclosure comprises one or more microstructure arrays, optionally affixed to a backing, such that at least one microstructure array is capable of penetrating into skin or tissues. In particular ~~embodiments~~examples, such devices comprise microstructures that penetrate into the superficial epidermis, epidermis, superficial dermis, or deep dermis. In other ~~embodiments~~examples, the wound closure device comprises a plurality of microstructure arrays such that the microstructures do not penetrate the skin or tissue surface.

In certain ~~embodiments~~examples, the wound closure devices may comprise at least two microstructure arrays as described herein, said arrays being optionally affixed to a backing. In some particular ~~embodiments~~examples, the wound closure devices may comprise two or more arrays optionally affixed to a backing, as described herein, such that at least two arrays are separated by space with no arrays. This space, referred to throughout as an "**isthmus**", may be of any suitable length, width, or shape, and may be comprised of any suitable material. In some ~~embodiments~~examples, the isthmus ranges from 1 mm in length to 15 mm in length. In certain ~~embodiments~~examples the isthmus is not stretchable, while in other ~~embodiments~~examples this space is stretchable.

In some ~~embodiments~~examples, the wound closure devices of the present ~~invention~~disclosure comprise one or more microstructures at an angle with respect to a base or backing. In one such embodiment, microstructures are angled in a way to translate the longitudinal tension from the skin pulling the wound apart along the device into a force that pushes the

device downward onto the skin, thus, *e.g.,* effectively anchoring the device onto the skin. Wound closure devices of the present ~~invention~~disclosure may in some ~~embodiments~~examples also include microstructure arrays comprising microstructures with variable angles relative to a base, *e.g.,* wherein at least two microstructures comprised in a single array extend from a base at different angles than one another. A non-limiting example of such an array, *e.g.,* is one that comprises both straight microstructures (*i.e.,* protruding from a base at a 90° angle) and angled microstructures (*e.g.,* protruding from the base at an angle less than 90°, such as 51°). Additionally, individual microstructure length can vary based upon its position in a microstructure array, or based upon its position on a wound closure device.

In various ~~embodiments~~examples, the microstructure arrays of the present ~~invention~~disclosure are fashioned or affixed upon a base in a particular shape or pattern, said shape or pattern optionally being of any shape or geometry described herein. In some ~~embodiments~~examples, such patterned arrays are further affixed to a backing (*e.g.,* a flexible and / or stretchable backing); while in other ~~embodiments~~examples they are not. In some certain ~~embodiments~~examples, arrays according to the present disclosure are fashioned or affixed on a base portion, optionally at an angle, wherein the arrays are patterned in a rectangular shape, said arrays comprising microstructures of any shape or geometry described herein; and said arrays optionally being affixed to a backing.

In some certain ~~embodiments~~examples, the wound closure devices of the present ~~invention~~disclosure comprise a plurality of microstructure arrays that are capable of penetrating or grasping skin or tissue; said arrays either being affixed to a flexible and stretchable backing, or being comprised on a single flexible and stretchable base, in a configuration such that at least two arrays are separated by an isthmus, as described herein; and said devices having the capability of being stretched across a wound and secured on either side *via* the traction or grip of the microstructures. Accordingly, such a device may be applied by first securing at least one microstructure array to the skin or tissue on one side of the wound, then stretching the device across the wound so as to secure another microstructure array to the skin or tissue on the other side of the wound. In such a manner, the retractile force of the stretched device can in some ~~embodiments~~examples pull and/or secure the wound closed, thus further promoting healing; while in other ~~embodiments~~examples such a force stabilizes the position of the device on the skin, but does not directly induce the closure of the wound.

In other certain ~~embodiments~~examples, the wound closure devices of the present ~~invention~~disclosure comprise a plurality of microstructure arrays that are capable of penetrating or grasping skin or tissue; said arrays either being affixed to a non-stretchable backing, or being comprised on a single non-stretchable base, in a configuration such that at least two arrays are separated by an isthmus, as described herein. In such ~~embodiments~~examples, the devices are useful *e.g.*, for securing tissue in place. Non-limiting examples of how this type of device may be used include the securing of a wound closed that has already been closed by some other method *e.g.*, *via* suturing, or with forceps.

The wound closure devices of the present ~~invention~~disclosure may optionally be covered to further protect the lesion from the surrounding environment, and to assist in maintaining proper securing of the device as placed. Covers may optionally comprise adhesive.

The wound closure devices of the present ~~invention~~disclosure may comprise microstructures of various shapes, sizes, and structures. Accordingly, in some ~~embodiments~~examples, one or more microstructure arrays are fashioned, optionally upon a base, said microstructures optionally comprising a variety of shapes, sizes, structures, and geometries; and said arrays optionally being affixed to a backing. Certain ~~embodiments~~examples provide for microstructures selected from the group consisting of microneedles, microblades, microanchors, microfishscale, micropillars, microhairs, and combinations thereof. The wound closure devices of the present ~~invention~~disclosure may comprise microstructure arrays comprising any density of microstructures. In some ~~embodiments~~examples, the density of microstructures comprised in an individual array varies from 2 microstructure per array, to more than 1000 microstructures per array. In certain ~~embodiments~~examples, the arrays comprise a density of microstructures arrays varying from 1 microstructure per cm^2 to 1000 microstructures per cm^2. Accordingly, in various ~~embodiments~~examples the array pitch is varied from approximately 30 μm to more than 1 cm.

The microstructures comprised in the wound closure devices disclosed herein may be made of any material or mixture of materials. In some ~~embodiments~~examples, the material is a natural material, or a mixture of natural materials; while in other ~~embodiments~~examples it is a synthetic material, or a mixture of synthetic materials. Still other ~~embodiments~~examples provide for microstructures, according to the present disclosure, comprising mixtures of one or more synthetic materials and one or more natural materials. In particular ~~embodiments~~examples, microstructures are made of a material selected from a polymer, a metal, a biomaterial, and a combination thereof. In some ~~embodiments~~examples, a microstructure of the present

~~invention~~disclosure is comprised of nanostructures, (*e.g.,* nanofibers). In some ~~embodiments~~examples, the microstructures are coated with nanostructures (*e.g.,* nanofibers). In some ~~embodiments~~examples the microstructures are comprised of, or consist essentially of biodegradable materials. In some ~~embodiments~~examples this is very important to ensure complications, such as inflammation, tissue damage, and infection, due to broken needles do not occur. In other ~~embodiments~~examples, the microstructures do not comprise biodegradable materials. In other ~~embodiments~~examples the microstructures comprise biodegradable materials and non-biodegradable materials.

In certain ~~embodiments~~examples, microstructures of the present ~~invention~~disclosure are comprised of a polymer selected from poly(methyl methacrylate) (PMMA), silicon, and chitin.

The wound closure devices of the present ~~invention~~disclosure may also optionally comprise other components such as, but not limited to, nanostructures (*e.g.,* nanostructure arrays or nanofibers); bioactive compounds (*e.g.,* drugs, therapeutics, hydrogels, healing substances, and combinations thereof), *etc.* In some particular ~~embodiments~~examples, the wound closure devices further comprise chitin (*e.g.,* chitin nanofibers). In other ~~embodiments~~examples the wound closure devices of the present ~~invention~~disclosure further comprise a hydrogel.

Some ~~embodiments~~examples of the present ~~invention~~disclosure provide for microstructure arrays designed to penetrate the skin to enable delivery of drugs or other therapeutic agents. In one particular embodiment, the microstructures are long enough to penetrate the skin, but not deep enough to reach nerve endings that cause pain. Some ~~embodiments~~examples can incorporate both microstructures coated with drugs as well as microstructures with open internal structure in which drugs can be incorporated.

In some ~~embodiments~~examples, the wound closure device is applied to the skin without the use of an applicator or instrument. In other ~~embodiments~~examples, the wound closure device is applied to the skin using an applicator or instrument, such as a forceps or tweezers, to hold the device, or to provide assistance in delivering force during the application of the device over the wound.

In some ~~embodiments~~examples, the wound closure devices of the present ~~invention~~disclosure may optionally include adhesive to assist in the application and optionally in the stabilization of the device upon the skin. Adhesive may be present on the device in any suitable location. In some ~~embodiments~~examples, the wound closure devices comprise an adhesive backing, or a base that comprises adhesive.

In some ~~embodiments~~examples, adhesive is provided to the device on a tab that is attached to at least one end of the device. The tab is not part of the device but is attached to the

device in order to enable adhesion. The device actually remains on the wound, while a tab can be removed. The tabs can be added to one or both distal ends of the device. In other ~~embodiments~~examples, adhesive is provided on a tab that is attached to at least one side of the device.

Still other ~~embodiments~~examples provide for devices as described herein comprising adhesive tabs positioned on at least one end and at least one side of the device. These adhesive tabs may be any length, optionally being shorter, longer, or equal in length to any one or more sides of the device. Furthermore, some ~~embodiments~~examples provide for adhesive tabs that are removable, *e.g.,* adhesive tabs comprising perforations that enable the adhesive portion to be easily torn off by hand. In some ~~embodiments~~examples the adhesive is any medical grade adhesive, such as, *e.g.,* an acrylate (such as, *e.g.,* is used on the Steri-Strips or Steri-Strip S isthmus), or hydrogel-based adhesives that can stick to wet surfaces (e.g., Polyethylene glycol (PEG) hydrogel). In other ~~embodiments~~examples the adhesive component comprises nanostructures that provide glueless adhesion. Adhesion of a device to skin or tissue induced by such adhesives may last for as little as a minute (*e.g.,* when the adhesive is utilized to help apply the device) or such adhesion may last for 10 days or more. Accordingly, adhesion to the skin or tissue as the result of an adhesive may last for 5 min, 10 min, 15 min, 20 min, 30 min, 60 min, 2 hr, 4 hr, 6 hr, 12 hr, 24 hr, 2 days, 4 days, 6 days, 8 days, 10 days, or more, including all integers (31 min, 32 min, 33 min, 13 hr, 14 hr, 15 hr, 3 day, 5 days, etc.) and ranges (1 min-10 days, 1 min-1 hr, 5 min-20 min, etc.) of the adhesion durations set forth herein.

~~Embodiments~~Examples of the present ~~invention~~disclosure provide for wound closure devices as disclosed herein that are available in a single package comprising only one such device, as well as packages comprising a plurality of said devices. In one embodiment, the wound closure devices are in the form of a roll, said roll optionally comprising individually wrapped wound closure devices, or alternatively a plurality of wound closure devices that are not individually wrapped. In particular ~~embodiments~~examples, the devices are sterile, and are packaged so as to maintain such sterility until being opened.

The present ~~invention~~disclosure furthermore provides for hand held dispensers that allow for easy application of the wound closure devices of the present ~~invention~~disclosure. In one embodiment, the dispenser is a roll-on, handheld dispenser, optionally enabling rapid single hand operation.

Some ~~embodiments~~examples of the present ~~invention~~disclosure further provide for a kit comprising a wound closure system. Wound closure systems comprise one or more wound closure devices, as described herein, as well as other optional components such as, *e.g.*, one or more cover (optionally comprising adhesive) to be applied over the wound closure device; one or more containers (*e.g.*, bottles, pouches, packets, tubes) comprising a drug or therapeutic which can optionally be applied to the wound prior to the application of the device; cleansing and/or sterilization means (*e.g.*, antiseptics, antibiotics, sterile saline); analgesics (*e.g.*, Benzocaine or Lidocaine); and instructions for using the various components of the wound closure system singly, or in combination.

The wound closure devices of the present ~~invention~~disclosure are suitable for treating internal and external wounds alike. In some ~~embodiments~~examples, the wound closure devices are applied to a subject's skin; and in other ~~embodiments~~examples the wound closure devices are applied to a subject's tissue (*e.g.*, internal tissue). Accordingly, the wound closure devices of the present ~~invention~~disclosure find utility in a variety of settings including, but not limited to, the treatment of wounds in urgent care settings (*e.g.*, surgery or trauma centers including emergency rooms, operating rooms, ambulances battlefields, and sites of accidents); in hospitals and clinics; in over the counter settings (*e.g.*, for use at home).

In some ~~embodiments~~examples, the wound closure devices of the present ~~invention~~disclosure have alternative utilities. For example, the devices disclosed herein may also be used in cosmetics, wherein microstructures, as described herein, may be used to penetrate the skin producing skin rejuvenation *via* acute injury resulting in stimulating the dermis and collagen formation inducing effects achieved with cosmetic laser procedures and skin rollers made of microneedles. This achieves improvement in the appearance of the skin by reducing wrinkles and increasing skin volume. In contrast to cosmetic laser procedures, application of the wound closure devices do not produce symptomatic inflammation resulting in pain, redness, swelling and temporary disfigurement; symptoms which can present for up to a few days after the laser procedure. In contrast to rollers made of microneedles, the wound closure devices can be applied to regions of the skin that are not easily accessible to microneedles, such as between the nose and mouth. In addition, our wound closure devices can be applied and left in place overnight or for days potentially providing more stimulation to the dermis than is achieved with short-term treatment with a microneedle roller. Finally, the wound closure device generates more

CLAIMS

1. A wound closure device comprising two or more microstructure arrays, each microstructure array comprising at least two microstructures, wherein the at least two or more microstructure arrays are attached to a flexible backing.

2. The wound closure device of Claim 1, wherein the number of microstructure arrays comprised on the device is 2.

3. The wound closure device of Claim 1, wherein the wound closure device is capable of maintaining a wound in a closed state.

4. The wound closure device of Claim 1, wherein the flexible backing is not stretchable.

5. The wound closure device of Claim 1, wherein the microstructure arrays are attached to the flexible backing in a configuration such that at least one of said microstructure arrays is capable of penetrating the skin on one side of a wound, and another one of said microstructure arrays is capable of penetrating the skin on another side of the wound.

6. The wound closure device of Claim 1, wherein the flexible backing comprises an adhesive.

7. The wound closure device of Claim 6, wherein the adhesive is located on one or more removable tabs.

8. The wound closure device of Claim 1, wherein the flexible backing is in the form of a roll bandage.

9. The wound closure device of Claim 1, wherein the two or more microstructure arrays are attached to the flexible backing such that they are separated by an isthmus.

10. The wound closure device of Claim 1, wherein the at least two microstructures are at an angle of from 15-90 degrees relative to the backing.

11. The wound closure device of Claim 1, wherein at least one microstructure is curved.

12. The wound closure device of Claim 1, wherein at least one microstructure is straight.

13. The wound closure device of Claim 1, wherein the length of the at least two microstructures is between 1 μm and 2 mm.

14. The wound closure device of Claim 1, wherein after application to tissue surrounding a wound, the wound closure device is covered with a protective cover.

15. The wound closure device of Claim 1, wherein the at least two microstructures comprise a material selected from a group consisting of silicone, chitin, polymethyl methacrylate (PMMA., metal, and a combination thereof.

16. The wound closure device of Claim 15, wherein the metal is titanium or steel.

17. The wound closure device of Claim 1, wherein the at least two microstructures are selected from the group consisting of microneedles, microblades, microanchors, microfishscale, micropillars, and microhairs.

18. The wound closure device of Claim 1, wherein the at least two microstructures comprise a shape selected from a group consisting of a rod, cone, square, rectangle, pyramid, and cylinder.

19. The wound closure device of Claim 1, wherein the wound closure device is configured to cause less inflammation or scarring in tissue that it is affixed to than is caused by a suture or staples.

CLAIMS

What is claimed is:

1. A wound closure device comprising one or more microstructure arrays, each comprising at least two microstructures.

2. The wound closure device of Claim 1, comprising a plurality of said arrays.

3. The wound closure device of Claim 2, wherein the plurality of arrays ranges from one array to 100 arrays.

4. The wound closure device of Claim 1, wherein the number of arrays comprised on the device is 1.

5. The wound closure device of Claim 1, wherein the number of arrays comprised on the device is 2.

6. The wound closure device of any one of Claims 1-5, wherein at least one microstructure is capable of penetrating into tissue and holding it in place.

7. The wound closure device of any one of Claims 1-5, wherein at least one microstructure is capable of holding tissue in place by grasping.

8. The wound closure device of Claim 6 or 7, wherein the tissue is skin.

9. The wound closure device of Claim 1, wherein the device is capable of closing a wound.

10. The wound closure device of Claim 1, wherein the device is capable of maintaining a wound in a closed state.

11. The wound closure device of Claim 1, wherein the one or more microstructure arrays are attached to a flexible backing.

12. The wound closure device of Claim 11, wherein the flexible backing is also stretchable.

13. The wound closure device of Claim 11, wherein a portion of the flexible backing which is capable of covering the wound has a stiffness greater than other portions of the device.

14. The wound closure device of Claim 12, wherein the stretchable backing comprises elasticity.

15. The wound closure device of Claim 14, wherein the elastic properties of the device vary along or across the device.

16. The wound closure device of Claim 11, wherein the flexible backing is not stretchable.

17. The wound closure device of any one of Claims 11-16, comprising a plurality of said microstructure arrays, configured on the flexible backing, such that at least one of said arrays is capable of penetrating the skin on one side of a wound, and another one of said arrays is capable of penetrating the skin on another side of the wound.

18. The wound closure device of Claim 11, wherein the backing comprises adhesive.

19. The wound closure device of Claim 18, wherein the adhesive binds the one or more microstructure arrays to the backing.

20. The wound closure device of Claim 18, wherein the adhesive binds to skin and assists in the application of the device.

21. The wound closure device of Claim 20, wherein the adhesive is located on one or more tabs.

22. The wound closure device of Claim 21, wherein the adhesive tabs are removable.

23. The wound closure device of Claim 22, wherein removal of the adhesive tabs prevents or reduces the severity of adhesive-induced allergic responses.

24. The wound closure device of Claim 20, wherein the adhesive further assists in maintaining the device in its intended positioning on the skin.

25. The wound closure device of Claim 18, wherein the adhesive is an acrylate or hydrogel based adhesives that can stick to wet surfaces.

26. The wound closure device of Claim 25, wherein the adhesive is a polyethylene glycol (PEG) hydrogel adhesive.

27. The wound closure device of Claim 11, wherein the backing is made of a material selected from the group consisting of medical tape, white cloth tape, surgical tape, tan cloth medical tape, silk surgical tape, clear tape, hypoallergenic tape, silicone, elastic silicone, polyurethane, elastic polyurethane, polyethylene, elastic polyethylene, rubber, latex, Gore-Tex, plastic and plastic components, polymers, biopolymers, natural materials, and combinations thereof.

28. The wound closure device of Claim 11, wherein the backing is made of at least a portion of a commercially available product selected from the group consisting of 3M Transpore Surgical Tape, 3M Blenderm Surgical Tape, Coverlet Fabric, Dynarex Silk Surgical Tape, Kendall™ Hypoallergenic Clear Tape, Tenderfix™ Hypoallergenic Cloth Tape, Curasilk™ Cloth Tape, Curapont, Leukosan Skinlink, Leukosan Strip, Leukostrip, Steri-Strip, Steri-Strip S, Urgo strip, and combinations thereof.

29. The wound closure device of Claim 11, wherein the backing is in the form of a roll bandage.

30. The wound closure device of Claim 11, wherein two or more microstructure arrays are attached to a flexible backing such that they are separated by an isthmus.

31. The wound closure device of Claim 30, wherein the isthmus length ranges from 1-15 mm.

32. The wound closure device of Claim 30, wherein the isthmus is either the same width as the backing, narrower than the backing, or wider than the backing.

33. The wound closure device of Claim 30, wherein the isthmus width ranges from 2 mm – 50 cm.

34. The wound closure device of Claim 1, further comprising a material selected from chitosan, chitin, and a mixture of chitin and chitosan.

35. The wound closure device of Claim 34, wherein the material is in the form of a powder, a gel, a hydrogel, a cream, an ointment, or combinations thereof.

36. The wound closure device of Claim 11, wherein the microstructures are at an angle of from 15-90 degrees relative to the base or backing.

37. The wound closure device of Claim 11, wherein the microstructures of at least one array have an acute angle relative the flexible backing and the microstructures of at least one array are at a 90° angle relative to the base or backing.

38. The wound closure device of Claim 11, wherein the microstructures are at a variable angle relative to the base or backing depending on the position of the microstructures on the device.

39. The wound closure device of Claim 11, which further comprises a visual stress indicator on the flexible backing.

40. The wound closure device of Claim 39, wherein the stress indicator is a painted strip.

41. The wound closure device of Claim 1, wherein the microstructures are up to 100 μm long.

42. The wound closure device of Claim 1, wherein the microstructures are up to 200 μm long.

43. The wound closure device of Claim 1, wherein the microstructures are up to 500 μm long.

44. The wound closure device of Claim 1, wherein the microstructures are up to 700 μm long.

45. The wound closure device of Claim 1, wherein the microstructures are up to 1000 μm long.

46. The wound closure device of Claim 1, wherein the microstructures are up to 100 μm wide where microneedle meets the foundation.

47. The wound closure device of Claim 1, wherein the microstructures are up to 200 μm wide where it meets the foundation.

48. The wound closure device of Claim 1, wherein the microstructures are up to 500 μm wide where it meets the foundation.

49. The wound closure device of Claim 1, wherein the microstructures are up to 700 μm wide where it meets the foundation.

50. The wound closure device of Claim 1, wherein the microstructures are up to 1000 μm wide where it meets the foundation.

51. The wound closure device of Claim 1, wherein the microstructure comprise a tip width ranging from 1 μm to 1000 μm.

52. The wound closure device of Claim 1, wherein the microstructures comprise a tip diameter ranging from 1 μm to 1000 μm.

53. The wound closure device of Claim 1, wherein the microstructures are in an array that comprises a number of microstructures that is less than a number selected from a group consisting of 1000, 500, 300, 100, 50, 25, 15, 10, 5, and 3.

54. The wound closure device of Claim 1, wherein the microstructures are in an array comprising from 2 to 20 microstructures per array.

55. The wound closure device of Claim 1, wherein the microstructures are in an array comprising at least two, three, four, five, or six microstructures per array.

56. The wound closure device of Claim 1, wherein the microstructures are in an array that comprises a number of microstructures per cm^2 that is less than a number selected from a group consisting of 1000, 500, 300, 100, 50, 25, 15, 10, 5, and 2.

57. The wound closure device of Claim 1, wherein the device has an area that is less than an area selected from the group consisting of 0.5 cm^2, 1 cm^2, and 2 cm^2.

58. The wound closure device of Claim 1, wherein each array comprises at least one, two, three, four, five, or six microstructures per cm^2.

59. The wound closure device of Claim 1, wherein the microstructure is curved.

60. The wound closure device of Claim 1, wherein the microstructures are distributed uniformly throughout the array.

61. The wound closure device of Claim 1, wherein the microstructures are distributed anisotropically throughout the array.

62. The wound closure device of Claim 1, wherein the length of the microstructures is between 1 μm and 2 mm.

63. The wound closure device of Claim 1, wherein the length of the microstructures is variable across and along the device.

64. The wound closure device of Claim 1, wherein said device is capable of being stretched across a wound site by using traction and grip of the microstructures on tissue adjacent to the wound.

65. The wound closure device of Claim 1, wherein after application to the tissue surrounding a wound, said device is covered with a protective cover.

66. The wound closure device of Claim 65, wherein the cover comprises adhesive.

67. The wound closure device of Claim 65, wherein the cover does not comprise adhesive.

68. The wound closure device of Claim 65, wherein the cover comprises a material with an appearance selected from a group consisting of transparent, opaque, colored, or patterned.

69. The wound closure device of Claim 65, wherein the cover comprises edges that are fashioned in a manner selected from the group consisting of curved, straight, or a combination thereof.

70. The wound closure device of Claim 69, wherein the cover comprises rounded edges; and wherein such a cover induces less irritation to the tissue surrounding the device than does a similar cover comprising straight edges.

71. The wound closure device of Claim 65, wherein the protective cover comprises a material selected from a group consisting of medical tape, white cloth tape, surgical tape, tan cloth medical tape, silk surgical tape, clear tape, hypoallergenic tape), silicone, elastic silicone, polyurethane, elastic polyurethane, polyethylene, elastic polyethylene, gauze, gel, hydrogel, silk, chitin, chitosan, cellulose, alginate, foam, shrink wrap, sheets, and hydrocolloids.

72. The wound closure device of Claim 65, wherein the protective cover comprises a commercially available product selected from a group consisting of Brown Medical - Sealtight Shower Dressing Protection Patch; Smith & Nephew Coversite Composite Cover Dressing; Coloplast Comfeel Plus Hydrocolloid Clear Thin Dressing; Systagenix Nu-Derm Bordered Hydrocolloid Wound Dressing; 3M Tegaderm Hydrocolloid Dressing; Smith & Nephew Replicare Thin Hydrocolloid Dressing; Smith & Nephew Replicare Hydrocolloid Wound Dressing; Hollister Restore Sterile Hydrocolloid Dressing; Hollister Restore Hydrocolloid Dressing with Foam; Backing; Hollister Restore Plus Hydrocolloid Dressing with Tapered Edge; Kendall Polyskin II Transparent Dressing; Smith & Nephew AlgiSite M Calcium Alginate Dressing; Kendall Curasorb Calcium Alginate Dressing; Deroyal Kalginate Calcium Alginate Dressing; Smith & Nephew Cica-Care Silicone Gel Sheeting; Molnlycke Mepiform Safetac Self Adherent Dressing with Soft Silicone for Scar Reduction; Molnlycke Mepitel Safetac Transparent Wound Contact Layer; Smith & Nephew OpSite Flexifix Transparent Film Roll; Systagenix Select Bioclusive Transparent Wound Dressing; Systagenix Select Bioclusive Transparent Wound Dressing; 3M Tegaderm Transparent Dressing First Aid Style; 3M Tegaderm Clear Absorbent Acrylic Dressing; Hartmann Cosmopore Adhesive Wound Dressing; 3M Tegaderm Transparent Film Dressing with Border; Kendall Telfa

Sterile Clear Wound Dressing; Smith & Nephew Allevyn Thin Gentle-Adhesive Polyurethane Dressing; and combination thereof.

73. The wound closure device of Claim 1, wherein the microstructures comprise a material selected from a group consisting of a polymer, a metal, a biomaterial, a glass, a hydrogel, and a combination thereof.

74. The wound closure device of Claim 73, wherein the microstructures comprise a material selected from a group consisting of silicone, chitin, polymethyl methacrylate (PMMA), and a combination thereof.

75. The wound closure device of Claim 1, wherein the microstructures are selected from microneedles, microblades, microanchors, microfishscale, micropillars, and microhairs.

76. The wound closure device of Claim 1, wherein the microstructures comprise a shape selected from a group consisting of a rod, cone, square, rectangle, pyramid, cylinder.

77. The wound closure device of Claim 1, wherein the microstructures are tapered, untapered, or partially tapered.

78. The wound closure device of Claim 1, wherein the microstructures comprise a tip that is symmetrical.

79. The wound closure device of Claim 1, wherein the microstructures comprise a tip that is not symmetrical.

80. The wound closure device of Claim 1, wherein the microstructures are beveled at the tip or along one or more of the sides extending down the length of the microstructure.

81. The wound closure device of Claim 1, wherein said device can be applied by hand without the use of an applicator.

82. The wound closure device of Claim 1, wherein said device can be applied with an applicator or instrument.

83. The wound closure device of Claim 1, wherein said device can be removed without the use of a tool or instrument.

84. The wound closure device of Claim 83, wherein said device can be removed simply by removing from the skin an adhesive cover that is affixed to the back of the device, thereby simultaneously removing the device and the cover.

85. The wound closure device of Claim 1, wherein the device causes less inflammation in the tissue that it is affixed to than is caused by suture or staples.

86. The wound closure device of Claim 1, wherein the closing of a wound with the device induces an inflammatory response in the tissue surrounding the wound that is reduced in comparison to the response induced by sutures or staples.

87. The wound closure device of Claim 1, wherein the closing of a wound with the device induces erythema in the tissue surrounding the wound that is reduced in comparison to the response induced by sutures or staples.

88. The wound closure device of Claim 1, wherein the closing of a wound with the device does not induce erythema in the tissue surrounding the wound.

89. The wound closure device of Claim 1, wherein the closing of a wound with the device induces edema in the tissue surrounding the wound that is reduced in comparison to the response induced by sutures or staples.

90. The wound closure device of Claim 1, wherein the closing of a wound with the device does not induce edema in the tissue surrounding the wound.

91. The wound closure device of Claim 1, wherein the device causes less skin scarring in the tissue that it is affixed to than is caused by sutures or staples.

92. A wound closure system comprising at least one of the wound closure devices of any one of Claims 1-91, wherein said system further comprises one or more adhesive covers, and optionally a container comprising chitin, chitosan, or a combination thereof.

93. The wound closure system of Claim 92, wherein the chitin and/or chitosan is in the form of a powder, a gel, a hydrogel, a cream, or an ointment.

94. A wound closure device, comprising a microstructure comprising a foundation adjacent to a base, a tip, and a body connecting the foundation to the tip.

95. The wound closure device of Claim 94, wherein a line extending from the tip perpendicular to the base passes through the foundation.

96. The wound closure device of Claim 94, wherein a line extending from the tip perpendicular to the base does not pass through the foundation.

97. The wound closure device of Claim 94, wherein an angle between the body and the base is a constant angle.

98. The wound closure device of Claim 94, wherein two or more different angles are formed between the body and the base between the foundation and the tip.

99. The wound closure device of Claim 98, wherein the body is articulated.

100. The wound closure device of Claim 98, wherein the body is curved.

101. The wound closure device of Claim 94, wherein the body comprises at least one concave surface.

102. The wound closure device of Claim 94, wherein the body comprises at least one convex surface.

103. The wound closure device of Claim 94, wherein the body comprises at least one concave surface and at least one convex surface.

104. The wound closure device of Claim 94, wherein the tip is selected from the group consisting of a microneedle and a microblade.

105. A method of applying any one of the wound closure devices of Claims 1-104 comprising affixing a first end of the device to the tissue directly adjacent to one side of the wound; optionally stretching the device across the wound; then affixing a second end of the device to the tissue directly adjacent to the other side of the wound.

106. The method of Claim 105, wherein the wound is treated with chitin, chitosan, or a combination thereof prior to affixing the device.

107. The method of Claim 105, wherein the wound is closed by the application of the device.

108. The method of Claim 107, wherein the closed wound is everted due to the action of the device.

109. The method of Claim 105, wherein the affixing is executed by placing the device in the desired position with the tips of the microstructures being oriented in contact with the tissue to which the device is meant to be affixed; applying pressure to the back of the microstructure array by pushing down on the base or backing directly behind the microstructures so as to induce the insertion of the microstructures into the tissue.

110. The method of Claim 105, wherein the affixing is executed using a roll-on handheld dispenser.

111. The method of Claim 105, further comprising covering the device with a cover after application of the device.

112. A method of treating a wound, comprising attaching at least one of the wound closure devices of any one of Claims 1-104 with or without first treating the wound with chitin and / or chitosan.