

Method And System For Providing Active Tissue Site Debridement

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Abstract

A wound debridement system includes a wound dressing having an active layer and a wound interface layer. The active layer is formed from one or more transmission layers that are arranged about a central post. Activation of the transmission layers is configured to cause the movement of the wound interface layer relative to a tissue site to which the wound dressing is applied. A drive unit is operably attached to the central post. The drive unit is configured to generate and transfer a vibrational energy and/or a rotational movement to the transmission layer(s) via the central post. The resultant vibration and/or rotation of the transmission layer(s) is imparted onto the wound interface layer, thereby effectuating the desired movement of the wound interface layer relative to the tissue site, which allows for the debridement of debris that may be located at the tissue site.

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This Application claims the benefit of priority to international patent application number PCT/US2019/033758, filed on May 23, 2019, which claims the benefit of priority to U.S. Provisional Application No. 62/676,588, filed on May 25, 2018, the complete disclosures of which are hereby incorporated herein by reference in their entireties.

BACKGROUND

(1) The present disclosure relates generally to tissue treatment systems, and more particularly, but without limitation, to a wound debridement system for active disruption and/or debridement of non-viable tissue at a tissue site without continual user intervention.

(2) During treatment of a tissue site, such as, e.g. a wound site, debris may develop on or in the tissue site. In various embodiments, the debris may include biofilms, necrotic tissue, foreign bodies, eschar, lacerated tissue, devitalized tissue, contaminated tissue, damaged tissue, infected tissue, exudate, highly viscous exudate, fibrinous slough and/or other material. The debris may cover all or a portion of the tissue site.

(3) The presence of debris in, on, or surrounding a tissue site may cause numerous problems. For example, debris that covers the tissue site may impair healing of the tissue site. Debris can also lower the effectiveness of beneficial tissue site treatments by preventing the treatments from reaching the tissue site. The presence of debris may also increase healing times and the risk of a more serious infection. Accordingly, in various embodiments, it may be desirable to disrupt the debris at a tissue site in order to promote healing of the tissue site.

SUMMARY

(4) One implementation of the present disclosure is an active debridement wound dressing including a wound interface layer and an active layer. The wound interface layer is configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound. The active layer is coupled to the wound interface layer and includes a transmission layer extending radially outwards relative to a central post. The transmission layer is configured to vibrate when activated so as to move the wound interface layer relative to the wound and mechanically debride the wound.

(5) In some embodiments, the transmission layer is formed from a plurality of arm members. In some embodiments, the plurality of arm members form an interconnected, interrupted planar structure.

(6) In some embodiments, the wound interface layer is formed from a foam-like material. A plurality of through-holes extend through the wound interface layer. The plurality of through-holes are distinct from pores which define the foam-like material from which the wound interface is formed. In some embodiments, the active debridement wound dressing includes an absorbent layer.

(7) In some embodiments, the transmission layer is positioned on top of a top surface of the wound interface layer and below a lower surface of the absorbent layer. In some embodiments, the transmission layer is at least partially embedded within the wound interface layer. In some embodiments, the transmission layer is entirely embedded within the wound interface layer.

(8) In some embodiments, the arm members are formed from a semi-rigid material. In some embodiments, the active layer includes a plurality of vertically spaced transmission layers. In some embodiments, the transmission layer is fixedly attached to the central post. In some embodiments, the transmission layer is movably attached to the central post, such that the transmission layer may be rotated relative to the central post.

(9) In some embodiments, the transmission layer is configured to vibrate in response to a vibrational energy being transmitted to the transmission layer by the central post.

(10) In some embodiments, the active debridement wound dressing includes a drive unit configured to generate a vibrational energy operably attached to the central post. A control unit may be coupled to the drive unit. The control unit is configured to activate the drive unit to generate a vibrational energy that is transmitted to the transmission layer.

(11) In some embodiments, the active debridement wound dressing includes a drape layer sealable to a patient's skin surrounding the wound. The drape layer is configured to maintain the wound dressing at a desired treatment area.

(12) In some embodiments, the active debridement wound dressing includes a semi-rigid support layer positioned between the drape layer and the wound dressing. The support layer is configured to prevent the wound dressing from sticking to the drape layer and to prevent the wound dressing from being unintentionally displaced from the desired treatment area in response to a vibrational energy being applied to the wound dressing.

(13) One implementation of the present disclosure is an active debridement wound dressing including a wound interface layer and an active layer. The wound interface layer is configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound. The active layer is coupled to the wound interface layer and includes a transmission layer extending radially outwards relative to a central post. The transmission layer is configured to rotate when activated so as to move the wound interface layer relative to the wound and mechanically debride the wound.

(14) In some embodiments, the transmission layer is formed from a plurality of arm members. In some embodiments, the plurality of arm members form an interconnected, interrupted planar structure.

(15) In some embodiments, the wound interface layer is formed from a foam-like material. A plurality of through-holes extend through the wound interface layer. The plurality of through-holes are distinct from pores which define the foam-like material from which the wound interface is formed. In some embodiments, the active debridement wound dressing includes an absorbent layer.

(16) In some embodiments, the transmission layer is positioned on top of a top surface of the wound interface layer and below a lower surface of the absorbent layer. In some embodiments, the transmission layer is at least partially embedded within the wound interface layer. In some embodiments, the transmission layer is entirely embedded within the wound interface layer.

(17) In some embodiments, the arm members are formed from a semi-rigid material. In some embodiments, the active layer includes a plurality of vertically spaced transmission layers. In some embodiments, the transmission layer is fixedly attached to the central post. In some embodiments, the transmission layer is movably attached to the central post, such that the transmission layer may be rotated relative to the central post.

(18) In some embodiments, the transmission layer is configured to rotate in response to a rotational movement being transmitted to the transmission layer by the central post.

(19) In some embodiments, the active debridement wound dressing includes a drive unit configured to generate a rotational movement operably attached to the central post. A control unit may be coupled to the drive unit. The control unit is configured to activate the drive unit to generate a rotational movement that is transmitted to the transmission layer.

(20) In some embodiments, the active debridement wound dressing includes a drape layer sealable to a patient's skin surrounding the wound. The drape layer is configured to maintain the wound dressing at a desired treatment area.

(21) In some embodiments, the active debridement wound dressing includes a semi-rigid support layer positioned between the drape layer and the wound dressing. The support layer is configured to prevent the wound dressing from sticking to the wound dressing and to prevent the wound dressing from being unintentionally displaced from the desired treatment area in response to a rotational movement being applied to the wound dressing.

(22) In some embodiments, the rotational movement that is transmitted to the transmission layer is configured to rotate the transmission layer relative to the central post and is also configured to rotate the central post relative to the wound. In some embodiments, the central post is configured to remain stationary relative to the wound when rotational movement is transmitted to the central post.

(23) In some embodiments, rotational movement that is transmitted to the central post is configured to rotate the central post relative to the wound while the transmission layer remains stationary relative to the central post.

(24) One implementation of the present disclosure is an active debridement wound therapy system including a wound interface layer, an active layer, and a therapy unit. The wound interface layer is configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound. The active layer is coupled to the wound interface layer and includes a transmission layer extending radially outwards relative to a central post. The transmission layer is configured to vibrate when activated so as to move the wound interface layer relative to the wound and mechanically debride the wound. The therapy unit is separate from the wound dressing and is configured to generate and apply a vibrational energy to the active layer.

(25) One implementation of the present disclosure is an active debridement wound therapy system including a wound interface layer, an active layer, and a therapy unit. The wound interface layer is configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound. The active layer is coupled to the wound interface layer and includes a transmission layer extending radially outwards relative to a central post. The transmission layer is configured to rotate when activated so as to move the wound interface layer relative to the wound and mechanically debride the wound. The therapy unit is separate from the wound dressing and is configured to generate and apply a rotational movement to the active layer.

(26) Those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting. Other aspects, inventive features, and advantages of the devices and/or processes described herein, as defined solely by the claims, will become apparent in the detailed description set forth herein and taken in conjunction with the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. 1 is a top perspective view of an active wound debridement system applied to a tissue site, according to an exemplary embodiment;

(2) FIG. 2 is an exploded top perspective view of a wound dressing according to an exemplary embodiment;

(3) FIG. 3A illustrates an active layer according to an exemplary embodiment;

- (4) FIG. 3B illustrates an active layer according to an exemplary embodiment;
- (5) FIG. 3C illustrates an active layer according to an exemplary embodiment;
- (6) FIG. 3D illustrates an active layer according to an exemplary embodiment;
- (7) FIG. 4A is a cross-sectional view of an active wound debridement system configured to impart a rotational movement to a wound dressing according to an exemplary embodiment;
- (8) and
- (9) FIG. 4B is a cross-sectional view of an active wound debridement system configured to impart a vibrational energy to a wound dressing according to an exemplary embodiment.

DETAILED DESCRIPTION

- (10) Referring to FIGS. 1-4, various embodiments of a wound debridement system **1** configured to disrupt areas of debris **7** at a tissue site **5**, such as, e.g. a wound site, are shown. The wound debridement system **1** is configured to provide continued, active and/or intermittent mechanical debridement of debris **7** at the tissue site **5** without requiring any additional user skill or effort to operate the wound debridement system **1** than would be required to apply and activate an existing negative pressure wound therapy ("NPWT") system, such as e.g. a V.A.C? therapy unit as available from Kinetic Concepts, Inc. (KCI) of San Antonio, Tex.
- (11) As shown in FIGS. 1, 4A and 4B, the wound debridement system **1** generally comprises a wound dressing **100**, a support layer **50** configured to allow the wound dressing **100** to vibrate and/or oscillate (i.e. rotate) freely under a drape layer **20**, a drape layer **20** that is configured to position the wound dressing **100** at a desired tissue site **5**, a drive unit **70** adapted to activate an active layer **40** (see, e.g. FIGS. 2 and 3A-3D), and a control unit **80** configured to control the activation of the active layer **40** by the drive unit **70**.
- (12) During operation of the wound debridement system **1**, the wound dressing **100** is positioned on or within a desired tissue site **5**. Once positioned, the support layer **50** is positioned atop the wound dressing **100**, and the support layer **50** and the wound dressing **100** are secured to the patient's skin using the drape layer **20**. In some embodiments, the drape layer **20** may be applied to the patient's skin so as to form a sealed, substantially fluid-tight treatment space surrounding the tissue site **5**.
- (13) The control unit **80** may be operated to control the activation of the active layer **40** by the drive unit **70**. The activation of the active layer **40** delivers a gentle vibrational energy and/or oscillatory movement to the wound interface layer **10** (see, e.g. FIGS. 1 and 2) so as to effectuate a slight displacement of the wound interface layer **10** relative to the tissue site **5**.
- (14) The movement of the wound interface layer **10** relative to the tissue site **5** acts to mechanically disrupt and debride debris **7** located at the tissue site **5**, and may also help minimize the ingrowth of debris into the wound dressing **100** during treatment of a tissue site **5** using the wound dressing **100**. Additionally, in some embodiments, the gentle vibration and/or oscillatory motion imparted onto the tissue site **5** may induce an acute inflammatory response that may promote in healing of the tissue site **5**.
- (15) The impact of the operation of the wound debridement system **1** on the tissue site **5** may depend on any number of factors, including the timing of the debridement, the tissue site **5** etiology, and/or any additional treatments that are applied to the tissue site **5**. For example, repeated debridement using the wound debridement system **1** early in the therapy regimen of a tissue site **5** may act to disrupt existing debris at the tissue site **5**. The repeated, continued debridement using the wound debridement system **1** during the therapy regimen of a tissue site **5** may be used to disrupt and/or inhibit the formation/accumulation of new debris **7** (e.g. biofilm).

(16) In some embodiments, treatment of the tissue site **5** may be enhanced by utilizing the wound debridement system **1** in conjunction with an additional therapeutic treatment system (such as, e.g., a negative pressure wound therapy (“NPWT”) and/or instillation therapy system). For example, in some embodiments, the wound debridement system **1** may be used to apply vibrations and/or oscillations from the drive unit **70** to the wound dressing **100** and tissue site **5** to disrupt and more easily solubilize debris **7** to enhance the effectiveness of NPWT and/or instillation therapy. Similarly, utilizing an instillation therapy treatment system to, e.g., apply pain management medication (e.g. topical lidocaine) and/or a solubilizing solution to the tissue site **5** during debridement may help to disrupt areas of stubborn debris **7** at the tissue site **5**.

(17) The wound debridement system **1** may be used to perform tissue site **5** debridement according to any number of different protocols. In some embodiments, operation of the wound debridement system **1** may be used with aggressive/fast debridement protocols, in which the wound debridement system **1** is operated for short periods of time over a treatment period, and in which the debridement may optionally be performed prior to, during, and/or following the delivery of a topical pain management medication to the tissue site **5**.

(18) In other embodiments, the wound debridement system **1** may be operated intermittently at a low-medium intensity one or more times per day, or may be operated continuously at low intensity over the span of the duration of a tissue treatment protocol so as to maintain the tissue site **5** free of debris during the tissue treatment. In yet other embodiments, the wound debridement system **1** may be operated in the hours/minutes immediately prior to the removal of the wound dressing **100** from the tissue site **5**. In such embodiments, the wound debridement system **1** may be operated at a high energy for a prolonged duration, e.g. one hour prior to the removal of the wound dressing **100**, so as to create a maximal disruption of debris, thereby facilitating removal of the wound dressing **100** (by disrupting any debris ingrown into the wound dressing **100**) and/or by minimizing or negating the need for bed-side debridement by a medical practitioner prior to the application of a new wound dressing **100** to the tissue site **5**.

(19) Wound Dressing

(20) In general, among other possible layers, the wound dressing **100** includes a wound interface layer **10** (see, e.g. FIGS. **1** and **2**) configured to provide mechanical movement which disrupts debris **7** at a tissue site **5** and an active layer **40** configured to drive the movement of the wound interface layer **10**. An absorbent layer **30** may optionally also be incorporated into the wound dressing **100**.

(21) The active layer **40** may be arranged relative to the wound interface layer **10** according to various embodiments. In some embodiments, such as, e.g. illustrated in FIGS. **4A** and **4B**, the transmission layer(s) **45** (described below) of the active layer **40** may be embedded within the wound interface layer **10**. In other embodiments, such as, e.g. illustrated in FIGS. **1** and **2**, the transmission layers **45** of the active layer **40** may be attached atop the wound interface layer **10**.

(22) In embodiments in which an absorbent layer **30** is included, the active layer **40** that is positioned atop the wound interface layer **10** may optionally be embedded in the absorbent layer **30**, or the active layer **40** may be positioned in between the wound interface layer **10** and the absorbent layer **30**. In other embodiments in which an absorbent layer **30** is included, the active layer **40** may be positioned atop both the wound interface layer **10** and the absorbent layer **30**. Also, it is to be understood that in yet other embodiments, the wound dressing **100** may be formed without an active layer **40**, with the active layer **40** instead being positioned atop the support layer **50** and/or atop the drape layer **20**.

(23) While the wound interface layer **10** and the absorbent layer **30** of the wound dressing **100** will typically be disposable, according to various embodiments, the active layer **40** may be capable of being reused with a new wound interface layer **10** and optional absorbent layer **30**. In embodiments in which the active layer **40** is intended to be reusable, the active layer **40** may advantageously be incorporated into the wound dressing **100** on top of the wound interface layer **10** (and below the absorbent layer **30**, if included) as opposed to being embedded, so as to facilitate the removal and reuse of the active layer **40**. Additionally, by configuring the active layer **40** to be capable of being

incorporated into the wound dressing **100** atop the wound interface layer **10**, existing wound dressings formed without an active layer **40** may be retrofitted to include the active layer **40**.

(24) The wound dressing **100** may be substantially planar or may be contoured for application to body surfaces having high curvature. For example, the wound dressing **100** may have a substantially convex or concave shape, or other customizable topography to adhere to wounds located on areas such as the knee or elbow.

(25) The size of wound dressing **100** can vary depending on the size of the tissue site **5** to be treated. For example, it is contemplated that the size of wound dressing **100** can be within a range of approximately 3 cm.sup.2 to approximately 150 cm.sup.2, and more preferably within a range of approximately 10 cm.sup.2 to approximately 50 cm.sup.2. However, other shapes and sizes of wound dressing **100** are also possible depending on intended use.

(26) i. Wound Interface Layer

(27) The wound interface layer **10** is adapted to contact a tissue site **5** along a lower, wound-facing surface **11** of the wound interface layer **10** to mechanically debride debris **7** at the tissue site **5** upon vertical, lateral and/or longitudinal movement of the wound interface layer **10** relative to the tissue site **5**. Although the wound interface layer **10** is shown as having a generally round shape, the wound interface layer **10** may be formed having any number of, and combination of, sizes, shapes, and/or thicknesses depending on a variety of factors, such as, e.g. the type of treatment being implemented or the nature and size of the tissue site **5** being treated, etc.

(28) Additionally, the size and shape of the wound interface layer **10** may be selected to accommodate the type of tissue site **5** being treated and the degree of contact (e.g. full or partial contact) desired between the tissue site **5** and the wound interface layer **10**. For example, if the tissue site **5** is a wound, the shape, size and thickness of the wound interface layer **10** may vary depending on whether the wound interface layer **10** is intended to partially or completely fill the wound, or if the wound interface layer **10** is intended to only be placed over the wound. If the wound interface layer **10** is intended to partially or completely fill the wound, the size and shape of the wound interface layer **10** may be adapted to the contours of the wound. In embodiments in which the wound interface layer **10** is configured to fill the wound, the wound interface layer **10** may optionally be cut to a size corresponding generally to the size and shape of the wound which the wound interface layer **10** is intended to treat.

(29) Any number of bio-compatible materials may be used to construct the wound interface layer **10**. A non-limiting, non-exhaustive list of the various materials that may be used to form the wound interface layer **10** may include: bioresorbable materials; materials configured to serve as a scaffold for new cell-growth, such as, e.g. calcium phosphate, collagen, PLA/PGA, coral hydroxy apatites, carbonates, or processed allograft materials; thermoplastic elastomers; 3D textiles, also referred to as a spacer fabric, such as the 3D textiles produced by Heathcoat Fabrics, Ltd., Baltex, and Mueller Textil Group; foam, such as e.g. GranuFoam?, V.A.C. VeraFlo? foam, or V.A.C. WhiteFoam?, each available from Kinetic Concepts, Inc. of San Antonio, Texas; etc.

(30) According to various embodiments, the materials used to form the wound interface layer **10**, the properties of the wound-facing surface **11** and/or the configuration and structure of the wound-facing surface **11** may be selected to enhance the ability of the wound interface layer **10** to disrupt debris **7** at the tissue site **5**. For example, in some embodiments, the wound-facing surface **11** may be formed of an abrasive material. In other embodiments, the wound-facing surface **11** may be defined by a textured surface having an uneven, coarse, or jagged profile that can induce strains and stresses at the tissue site **5**. In such embodiments, the wound-facing layer may be formed of an abrasive or non-abrasive material. In yet other embodiments, the wound interface layer **10** may be formed of an abrasive or non-abrasive compressible material, with the compression of the compressible material being adapted to increase the amount by which the wound-facing surface **11** is translated or oscillated laterally and/or longitudinally relative to the tissue site **5** during treatment.

(31) In various embodiments, the wound-facing surface **11** of wound interface layer **10** may be formed having a generally solid, continuous, uninterrupted surface. In other embodiments, particularly when the wound debridement system **1** is used in conjunction with a NPWT treatment or other treatment in which negative pressure is applied to the tissue site **5**, the ability of the wound interface layer **10** to disrupt debris **7** at the tissue site **5** may be enhanced via the selective removal of areas or portions of the wound-facing surface **11**.

(32) For example, as illustrated in FIGS. **1** and **2**, in one embodiment, the wound interface layer **10** may be constructed with a plurality through-holes **13** extending entirely or partially through the wound interface layer **10** from the wound-facing surface **11** to an upper surface **12** of the wound interface layer **10**.

(33) The plurality of through-holes **13** may have any number of different shapes and may be arranged about the wound interface layer **10** in any desired manner to define any number of different uniform or non-uniform patterns (such as, e.g., perforated, grid-like, honeycombs, etc.) extending entirely or partially from the wound-facing surface **11** to the upper surface **12** of the wound interface layer **10**.

(34) The dimensions of the through-holes **13** may be varied as desired. While in some embodiments each of the through-holes **13** may have identical dimensions, in other embodiments the through-holes **13** may be formed having varied dimensions. Regardless of the dimensions selected for the through-holes **13**, in embodiments in which the wound interface layer **10** is formed from a foam-like or other porous material, it is to be understood that the through-holes **13** do not include the pores of the material forming the wound interface layer **10**, but rather are discrete perforations formed through the material forming the wound interface layer **10**.

(35) The through-holes **13** may be arranged about the wound interface layer **10** in any number of desired arrangements or patterns, including a random arrangement of the through-holes **13** about the wound interface layer **10**. As illustrated in FIG. **2**, in some embodiments, the through-holes **13** may be arranged linearly, with adjacent rows of through-holes **13** optionally being offset from one another.

(36) As shown in FIG. **2**, in some embodiments, the through-holes **13** may have a circular shape. In other embodiments, the through-holes **13** may be formed having any number of other shapes, or any combination of different shapes, including, e.g. hexagonal, ovoid, or triangular shapes. When contracted, through-holes **13** having different cross-sectional shapes may generate and distribute concentrated stresses in different dimensions, and may accordingly influence disruption of debris **7** in different ways. As such, in various embodiments the cross-sectional shape of the through-holes **13** may be based on the tissue site **5** being treated and/or the degree of abrasion that may be desired at the tissue site **5**.

(37) Regardless of the shape, size, arrangement, or degree to which the through-holes **13** extend through the wound interface layer **10**, the through-holes **13** formed in the wound interface layer **10** define void spaces in the wound-facing surface **11**. In response to the wound interface layer **10** being compressed (e.g. as a result of activation of the active layer **40** and/or upon application of negative pressure in embodiments in which the wound debridement system **1** is used in conjunction with a NPWT device), the voids provide spaces into which the wound-facing surface **11** is laterally and/or longitudinally collapsed. As the wound-facing surface **11** is compressed from its initial, relaxed configuration into the spaces defined by the voids, the lateral and/or longitudinal translation of the wound-facing surface **11** relative to the tissue site **5** concentrates a shear force on the tissue site **5** that allows for the disruption of the debris **7** at the tissue site **5**.

(38) The disruption of the debris **7** at the tissue site **5** may also be augmented by the localization of forces along the edges **14** of the through-holes **13** during compression of the wound interface layer **10**, which may result in the edges **14** acting as cutting surfaces that disrupt debris **7** at the tissue site **5**. Additionally, in some embodiments, as a result of the compression of the wound interface layer **10**, debris **7** may become trapped within the voids as the through-holes **13** collapse. Forces concentrated by the inner vertical surfaces **15** of the walls of the through-holes **13** on this trapped debris **7** may act to provide additional disruption of the debris **7** at the tissue site **5**.

(39) In some embodiments (not shown), the selective removal of areas or portions of the wound interface layer **10** may be provided in the form of the wound interface layer **10** being formed of a plurality of discrete or connected segments. In an initial configuration—prior to the compression of the wound interface layer **10**—the segments may be arranged and spaced relative to one another with voids separating adjacent segments, such that the wound-facing surface **11** of the wound interface layer **10** is defined by a non-solid, interrupted surface. The segments may be arranged relative to one another such that, upon compression of the wound interface layer **10** (e.g. in response to a negative pressure applied via a NPWT system used in conjunction with the wound debridement system **1**), the segments collapse inwards to form a substantially solid, compact surface defined by the inter-fitted arrangement of adjacent segments with one another.

(40) The effect of the contraction of the segments of wound interface layer **10** is similar to the effect of the contraction and collapse of through-holes **13** of wound interface layer **10** embodiments such as that illustrated in, e.g. FIG. **2**. In particular, the translation of the segments relative to the tissue site **5** concentrates a shear force on the tissue site **5** as the segments are collapsed and translated into the inter-fitted, compressed segment configuration. Also, concentrated forces imparted by the edges of segments on the debris as well as forces imparted by the vertical surfaces of segments on debris **7** that becomes trapped between adjacent segments as the wound interface layer **10** collapses assist in the debridement of debris **7** at the tissue site **5**.

(41) According to various embodiments, the density of the material used to form the wound interface layer **10** may be varied as desired to control the degree by which the wound interface layer **10** may be vibrated, oscillated and/or otherwise moved relative to the tissue site **5** in response to the vibrational energy and/or oscillatory movement that is imparted onto the wound interface layer **10** by the active layer **40**. Similarly, in embodiments in which the wound interface layer **10** is formed with a plurality of through-holes **13**, the thickness of the walls separating adjacent through-holes **13** and/or the size of the openings defined by through-holes **13** may also be varied to control the degree by which the wound interface layer **10** may be vibrated, oscillated and/or otherwise moved relative to the tissue site **5** in response to the vibrational energy and/or oscillatory movement that is imparted onto the wound interface layer **10** by the active layer **40**.

(42) ii. Active Layer

(43) Active layer **40** is configured to intentionally translate the wound dressing **100** in a horizontal and/or vertical direction relative to the tissue site **5** such that unhealthy tissue or other debris **7** may be debrided from the tissue site **5**. In various embodiments, upon activation of the drive unit **70**, the active layer **40** is adapted to oscillate/rotate (e.g. concentrically, eccentrically, orbitally, etc.) and/or vibrate to achieve a desired translation of the wound interface layer **10**.

(44) As illustrated in FIGS. **2** and **3**, the active layer **40** generally comprises one or more transmission layers **45** extending radially outwards from a central post **47** that is operably connected to a drive unit **70**. Upon activation of the drive unit **70**, vibration and/or oscillation imparted by the drive unit **70** to the central post **47** is further transmitted to some or all of the transmission layers **45** via the central post **47**, with the resultant vibration and/or oscillation of the one or more transmission layers **45** being transferred to the wound interface layer **10** to effectuate mechanical debridement of debris **7** at the tissue site **5**.

(45) In embodiments in which the active layer **40** is configured to be oscillated/rotated by the drive unit **70**, such as, e.g. illustrated in FIG. **4A**, the activation of the active layer **40** may result in rotation of the transmission layer **45** about the central post **47** while the central post **47** remains stationary relative to the tissue site **5**. In other such embodiments, activation of the active layer **40** may result in rotational movement of the transmission layer **45** and central post **47** relative to the tissue site **5** while maintaining the transmission layer **45** stationary relative to the central post **47**. In yet other embodiments, activation of the active layer **40** may result in orbital movement of the transmission layer **45** and central post **47**, with the transmission layer **45** rotating relative to the central post **47** while both the transmission layer **45** and the central post **47** are rotated relative to the tissue site **5**.

(46) In any such embodiments in which oscillatory/rotational movement is used to drive the active layer **40**, it is to be understood that the transmission layer(s) **45** and/or central post **47** may be activated to achieve any desired degree of rotation. According to various embodiments, the transmission layer **45** and/or central post **47** may be activated by the drive unit **70** to rotate by less than approximately 30 degrees of rotation, and more preferably less than approximately 5 degrees. According to some embodiments, this small back and forth rotational movement may be effectuated via high frequency vibrations imparted by the drive unit **70**.

(47) a. Transmission Layer

(48) The transmission layer **45** defining the active layer **40** may be formed according to any number of embodiments, with the transmission layer **45** being adapted such that the selection of shape, size, configuration and/or materials used to form the transmission layer **45** may allow a user control the rate and degree of movement of the wound interface layer **10** relative to the tissue site **5** during operation of the wound debridement system **1**. As illustrated in FIGS. **3B** and **3C**, according to various embodiments, the active layer **40** may comprise a single transmission layer **45**, while in other embodiments, such as, e.g. illustrated in FIGS. **2**, **3A** and **3D**, the active layer **40** may comprise a plurality of vertically spaced transmission layers **45**.

(49) In general, as compared to, e.g. applying vibrational/oscillatory energy along a top of the drape layer **20**, which results in much of the vibrational/oscillatory energy being directed to the skin around the tissue site **5**, the transmission layer **45** is configured to distribute/transmit the vibrations/oscillations that are delivered thereto from the drive unit **70** directly to the wound dressing **100**, such that vibrations/oscillations transmitted via the transmission layer **45** are more directly applied to tissue site **5** than those applied along the top of the drape layer **20**.

(50) According to various embodiments, the degree of vibrational energy and/or rotational movement that is transferred to the wound interface layer **10** by the active layer **40** may be controlled via the selection of the rigidity of the material(s) used for the transmission layer(s) **45**, with more rigid materials being capable of transferring a greater amount of energy and/or movement to the wound interface layer **10** than less rigid materials. As such, in embodiments in which more aggressive wound debridement is desired, the transmission layer(s) **45** may be formed from a more rigid material than would be used to form the transmission layer(s) **45** of a wound debridement system **1** intended to be used in a gentler debridement procedure. In various embodiments, the materials used to form the transmission layer(s) **45** may comprise any number of materials, including e.g. various mid-durometer polymers.

(51) As shown in FIGS. **2** and **3**, the one or more transmission layers **45** are positioned about and extend radially outwards from a central post **47** to which the drive unit **70** is attached. Upon activation of the drive unit **70**, the vibrational energy and/or oscillatory movement generated by the drive unit **70** is transmitted through the central post **47** to drive the transmission layer(s) **45**. According to various embodiments, such as, e.g. shown in FIGS. **2**, and **3B-3D**, the transmission layer(s) **45** may be fixedly attached to the central post **47**, such that any vibration or movement of the central post **47** is directly transmitted to the transmission layer(s) **45**. In other embodiments, such as, e.g. shown in FIG. **3A**, the transmission layer(s) **45** may be movably attached to the central post **47** (via e.g. an attachment of the transmission layer **45** to a collar **48** that rotatably surrounds the central post **47**), such that the vibrational energy and/or oscillatory movement of the central post **47** may be selectively transmitted to the transmission layer(s) **45**.

(52) In some embodiments, the transmission layer **45** may comprise a generally solid, continuous, and planar structure that extends radially outwards from the central post **47**. In other embodiments, the transmission layer **45** may be defined by a non-continuous, planar structure that extends partially or entirely about the central post **47** and which is formed of one or more rigid or semi-rigid arm members **43**. In various embodiments, the outermost dimensions of the transmission layer **45** may be customizable (e.g. the transmission layer **45** may be trimmable) such that the outermost dimensions of the transmission layer **45** may be adapted to the size and shape of the tissue site **5**.

(53) In embodiments in which the transmission layer(s) **45** is comprised of one or more rigid or semi-rigid arm members **43**, the arm members **43** may be formed as discrete elements, with each individual arm member **43** being independently attached to the central post **47**, such as e.g. illustrated in FIGS. **2** and **3A**. In other embodiments, such as, e.g. illustrated in FIGS. **3B-3D**, the transmission layer(s) **45** may be defined by a structure formed of a plurality of monolithically or integrally interconnected arm members **43**. In such embodiments, the pattern, arrangement and spacing of the arm members **43** may advantageously be varied and selected as desired so as to provide for the desired vibration and/or oscillation of the active layer **40** upon activation of the drive unit **70**. In such embodiments, the arm members **43** may form an interconnected structure defined by any number of uniform or non-uniform patterns and designs, such as, e.g. a spiderweb, target-shaped, grid, spiral, hub-and-spoke, etc.

(54) As described below, in various embodiments, the drive unit **70** may be adapted to generate varying levels of vibrational energy and/or rotational movement, such that varying degrees of movement of the wound interface layer **10** relative to the tissue site **5** may be achieved. In other embodiments, the selection of materials used to form the transmission layer **45** (such as, e.g. forming differing transmission layers **45** from materials having differing rigidities) may also be used to achieve varying degrees of movement of the wound interface layer **10** relative to the tissue site **5**.

(55) In some embodiments, additional control over the degree of movement of the wound interface layer **10** relative to the tissue site **10** may be provided by operatively isolating one or more transmission layers **45** from each other, such that vibration and/or oscillation of one or more transmission layers **45** may be induced via vibrational energy and/or rotational movement transferred from the central post **47** without automatically inducing vibration and/or oscillation in other transmission layers **45**. In such embodiments, the selective activation of certain operatively isolated, individual transmission layers **45** may provide additional control over the degree and/or extent of vibration and/or oscillation that the wound interface layer **10** is subject to.

(56) iii. Film Layer

(57) As noted above, in various embodiments, the transmission layer(s) **45** of active layer **40** may be embedded within the wound interface layer **10** and/or the absorbent layer **30**. However, in embodiments in which the transmission layer(s) **45** of active layer **40** are provided as a discrete, non-embedded layers, wound dressing **100** may optionally include a film layer (not shown) to which the transmission layer(s) **45** of the active layer **40** may be mounted, laminated, attached or otherwise interconnected to, with the film layer also being used as the basis by which the transmission layer(s) **45** may be affixed to the wound interface layer **10** and/or absorbent layer **30**. Alternatively, in some embodiments in which the active layer **40** is not embedded, the film layer may be omitted, with the transmission layer(s) **45** of the active layer **40** being attached directly to the wound interface layer **10** and/or absorbent layer **30**.

(58) The size and shape of the film layer may be varied as desired. In various embodiments, the outer periphery of the film layer may be shaped and sized to generally correspond to, or optionally be smaller than, the outer periphery of the wound interface layer **10**.

(59) The film layer may be adapted to elastically deform upon application of a stretching force to the wound dressing **100**. For example, in some embodiments, the film layer may be designed to elastically stretch when a stretching force is applied and elastically recover when the stretching force is removed, such as, e.g. may occur as a result of the vibration and/or rotation of the transmission layer(s) **45** that is supported by film layer. In other words, film layer may be configured to exhibit substantially elastic deformation and recovery.

(60) Film layer may be a thin layer made of any number of elastic materials. For example, film layer may be a polyurethane film, a polyethylene film, or other thin elastic. In some embodiments, film layer may be substantially impermeable to liquid and substantially permeable to moisture vapor.

(61) In embodiments in which the wound debridement system **1** will be used with additional therapeutic treatments, such as, e.g. NPWT or instillation therapy, film layer may optionally include one or more fenestrations adapted to allow for the transfer of fluids and pressure to/from the wound interface layer **10**. The fenestrations may also be adapted to reduce the amount of force required to stretch film layer.

(62) In some embodiments, film layer may comprise an upper film and a lower film that encapsulate the transmission layer(s) **45** of the active layer **40**. In some such embodiments, one or both of the upper film and the lower film may include fenestrations.

(63) iv. Absorbent Layer

(64) An absorbent layer **30** may optionally be coupled to the active layer **40** opposite the wound interface layer **10**, such that the active layer **40** is encapsulated between the absorbent layer **30** and the wound interface layer **10**. The absorbent layer **30** may act as a manifold that is adapted to collect and/or distribute fluid and/or pressure across a tissue site **5**. For example, the absorbent layer **30** may be adapted to receive and distribute negative pressure across a tissue site **5** to which the wound dressing **100** is applied, allowing for the wicking of fluid (e.g. exudate) from the tissue site **5** and providing a distributed compressive force along the tissue site **5**. As another example, the absorbent layer **30** may be used to facilitate the delivery of fluid across a tissue site **5**.

(65) In embodiments incorporating an absorbent layer **30**, the size and shape of the absorbent layer **30** may be varied as desired. In various embodiments, the outer periphery of the absorbent layer **30** may be shaped and sized to generally correspond to, or optionally be smaller than, the outer periphery of the wound interface layer **10**. As illustrated in FIG. **2**, the absorbent layer **30** may include a port opening **35** through which the central post **47** of the active layer **40** and/or the drive shaft **73** of the drive unit **70** extends.

(66) Any material or combination of materials might be used for the absorbent layer **30**. In some embodiments, the absorbent layer **30** may comprise a porous and permeable foam layer, with the absorbent layer **30** being formed from a reticulated, open-cell polyurethane or polyether foam that allows good permeability of wound fluids while under a reduced pressure. In one non-limiting example, the absorbent layer **30** may be an open-cell, reticulated polyurethane foam such as GranuFoam[®] dressing available from Kinetic Concepts, Inc. of San Antonio, Tex. In other embodiments the absorbent layer **30** may be an open-cell, reticulated polyurethane foam such as a V.A.C. VeraFlo[®] foam, also available from Kinetic Concepts, Inc., of San Antonio, Tex. In yet other embodiments, the absorbent layer **30** may be formed of un-reticulated open-cell foam.

(67) Support Layer

(68) In some embodiments, the wound debridement system **1** may further comprise a support layer **50** positionable over the wound dressing **100** that is configured to maintain the wound dressing **100** in place during operation of the wound debridement system **1**, while also preventing the wound dressing **100** from sticking to the drape layer **20**. According to one embodiment, support layer **50** may be a support layer such as that shown and described in U.S. patent application Ser. No. 16/678,450, the complete disclosure of which is incorporated herein by reference in its entirety.

(69) The inclusion of such a support layer **50** may be particularly advantageous in embodiments in which the wound debridement system **1** is used to treat tissue sites **5** located on areas of the body that encounter a wide range of motion and frequent movement, such as, e.g. elbow, knee cap, etc.

(70) In general, the support layer **50** is configured to dampen the vibration and/or oscillation of the wound dressing **100** to prevent the wound dressing **100** from being displaced relative the treatment tissue site **5** as a result of the vibratory and/or oscillatory forces imparted onto the wound dressing **100** by the drive unit **70** and to maintain a close contact between the wound interface layer and the tissue site **5** during treatment. In such a manner, the support layer **50** may be adapted to ensure that the movement of the wound interface layer **10** is localized to movement within an area corresponding to the tissue site **5** such that debridement at the tissue site **5** may be achieved. As illustrated in FIG. **2**,

the support layer **50** may include a port opening **55** through which the central post **47** of the active layer **40** and/or the driving shaft **73** of the drive unit **70** extends.

(71) In some embodiments, support layer **50** may comprise a semi-rigid and porous material, such as a rubber or plastic material such as polyurethane. In other embodiments, support layer **50** may comprise a substantially rigid material, which may be non-porous and non-permeable. In still other embodiments, support layer **50** may comprise areas of differing rigidity, such that support layer **50** is configured to match the anatomy of a particular tissue site **5**. Support layer **50** may also have areas of differing thickness to further match the contours of a particular tissue site **5**.

(72) Advantageously, support layer **50** may be formed by a process such as three-dimensionally printing or casting that allows for the customization of the support layer **50** to a particular tissue site **5**. The three-dimensional printing or casting of the support layer **50** allows for the creation of a wound dressing **100** contoured to the unique shape and size of the tissue site **5**, such that the wound debridement system **1** may be better adhered to the unique tissue site **5** that is to be treated. Additionally, support layer **50** may be printed or casted to have areas of varying thickness or rigidity in order to better match the contours of the tissue site **5**.

(73) In some embodiments, support layer **50** includes an antimicrobial agent or other active agents to promote effective wound healing and/or which may interact with the wound bed to breakdown wound exudate. Non-limiting examples of such active materials may include antimicrobial silver, silver oxidized regenerated cellulose (ORC) (e.g., approximately 25 wt % ionically bound silver), polyhexamethylene biguanide (PHMB), nonsteroidal anti-inflammatory drugs such as acetaminophen, steroids, anti-inflammatory cytokines, anesthetics, antimicrobial agents such as penicillin or streptomycin, antiseptics such as chlorhexidine, growth factors such as fibroblast growth factor (FGF), a platelet derived growth factor (PDGF), or an epidermal growth factor (EGF), and other therapeutic agents, individually or in any combination. If present, such active materials may typically be included at any effective level that show therapeutic efficacy, while preferably not being at such a high level as to significantly counteract any critical or desired physical, chemical, or biological property of the dressing. Depending upon the therapeutic goal, any active material may be loaded at a level of from about 10 wppm to about 10 wt % of the layer in which it is present, for example, from about 50 wppm to about 5 wt % or from about 100 wppm to about 1 wt %. The active material may be contained within a thin film on second side **120** of support layer **50** or may be distributed within support layer **50**.

(74) In embodiments in which the wound dressing **100** does not include an absorbent layer **30** and the wound interface layer **10** is formed with a plurality of through-holes **13**, the support layer **50** may comprise one or more surface disruptors (not shown) distributed along a lower surface of support layer **50** to facilitate in the disruption and fragmentation of debris **7** that becomes trapped within the through-holes **13**. Non-limiting examples of surface disruptors include, e.g. projections, protrusions, texture, abraders, microspikes, etc.

(75) Drape Layer

(76) A drape layer **20** adapted to seal to a patient's skin may advantageously be provided to position and maintain the active debridement wound dressing **100** about the desired treatment tissue site **5**. An attachment device, such as e.g. an adhesively coated margin **23**, as illustrated e.g. in FIG. **1** may be used to attach the drape layer **20** to a desired location along the patient's skin. In various embodiments, the drape layer **20** may provide a bacterial barrier and protection from physical trauma, and may be permeable to water vapor but impermeable to liquid. In the embodiment shown in FIG. **1**, drape layer **20** may include a port opening **25** through which the central post **47** and/or the driving shaft **73** of the drive unit **70** extends.

(77) Drape layer **20** may be formed from any number of materials, such as, e.g. polyurethane film. In some embodiments, the drape layer **20** may be adapted to provide a fluid-tight seal with the patient's skin surrounding the tissue site **5** that is to be treated. In such embodiments, the drape layer **20** may be constructed from a material adapted to reduce evaporative losses and provide and maintain a fluid seal. As non-limiting examples, the drape layer **20** may be formed from materials that include a

silicone, 3M Tegaderm? drape material, acrylic drape material such as one available from Avery, or an incise drape material.

(78) Attachment Port

(79) As illustrated in FIGS. **1** and **2**, in various embodiments, an attachment port **90** may be provided on the drape layer **20** or the support layer **50**. The attachment port **90** may advantageously provide a fluid tight seal that allows for the central post **47** to be operably attached to a driving shaft **73** of the drive unit **70** while maintaining the sterility of the interior of the wound debridement system **1**. In some embodiments, the attachment port **90** may provide for such a sterile connection via the inclusion of a check valve. One non-limiting example of an attachment port **90** that may be used is a SENSAT.R.A.C.? port as available from Kinetic Concepts, Inc. (KCI) of San Antonio, Tex.

(80) Referring to FIG. **4B**, in some embodiments in which the drive unit **70** is configured to generate a vibrational energy and in which the attachment port **90** is attached about an upper surface of the support layer **50** or drape layer **20**, the attachment port **90** may optionally also be configured to transfer vibrational energy received from the drive unit **70**. Such embodiments may be advantageous, e.g., where the wound debridement system **1** is used in conjunction with a NPWT treatment system in which debris is removed by the NPWT system via a conduit that passes through the attachment port **90**. In particular, the vibrational energy imparted by the attachment port **90** may be configured to assist in breaking up and/or solubilizing debris passing through the conduit, such that the vibrational energy imparted by the attachment port **90** may be used to prevent blockage of the conduit.

(81) Drive Unit

(82) The drive unit **70** of the wound debridement system **1** is configured to transmit vibrational energy and/or rotational movement to the active layer **40** to effectuate movement of the wound interface layer **10** relative to the tissue site **5**. As will be understood, the drive unit **70** may incorporate any known type of transducer, such as, e.g. a flat planar piezoelectric or magnetostrictive transducer capable of transforming electrical signals into longitudinal or transverse vibrations and/or rotational movement. According to various embodiments, the drive unit **70** may be configured to operate at frequencies within a range of between approximately 2 Hz to approximately 400 Hz, and more specifically frequencies within a range of between approximately 20 Hz to approximately 200 Hz.

(83) In some embodiments, e.g. as illustrated in FIGS. **4A** and **4B**, the drive unit **70** may be provided external to the drape layer **20**, support layer **50**, and/or wound dressing **100**, with a drive shaft **73** of the drive unit **70** being operably attached to the central post **47** of the active layer **40** through an attachment port **90**. In other embodiments (not shown), the drive unit **70** may be located within the drape layer **20** and/or support layer **50**, such that the wound debridement system **1** defines a self-contained unit that may be positioned at the desired tissue site **5**.

(84) Control Unit

(85) The activation of the active layer **40** by the drive unit **70** may be based upon signals received from an optionally included control unit **80**. In some embodiments, the control unit **80** and drive unit **70** may be formed as a single unit, while in other embodiments the drive unit **70** and control unit **80** may be provided separately. The communication between the control unit **80** and the drive unit may be accomplished using any number of known communication methods, including wireless communication.

(86) As will be understood, in addition to simply starting and stopping the movement of the active layer **40**, the control unit **80** may also be adapted to allow for the adjustment and variation of the movement of the active layer **40**. The control unit **80** may be adapted to vary the degree of vibrational energy and/or rotational movement generated by the drive unit **70** based on any number of factors including, but not limited to: the tissue site **5** being treated (such as, but not limited to bone tissue, adipose tissue, muscle tissue, neural tissue, dermal tissue, vascular tissue, connective tissue, cartilage, tendons, or ligaments, chronic, acute, traumatic, subacute, and dehiscent wounds, partial-thickness burns, ulcers, flaps, grafts, etc.); the type of debris **7** being debrided (such as, but not limited to

necrotic tissue, eschar, impaired tissue, other sources of infection, exudate, slough including hyperkeratosis, pus, foreign bodies, biofilm, or other types of bioburden, etc.); the thickness, consistency, color and/or moisture levels of the debris **7**; the desired relative amount of movement of the wound interface layer **10** relative to the tissue site **5**; etc.

(87) Standalone Use and Use With Other Treatment Systems

(88) In various embodiments, wound debridement system **1** may be used as a standalone therapy device, with drive unit **70** and optional control unit **80** being provided solely for the operation of the wound debridement system **1**. However, as noted previously, in other embodiments it may be possible to utilize the wound debridement system **1** in conjunction with one or more additional therapeutic treatment systems configured to provide a desired therapeutic treatment to the tissue site **5** in addition to the debris **7** debridement provided by the wound debridement system **1**.

(89) In embodiments in which the wound debridement system **1** is used in conjunction with another therapeutic treatment system, one or more of the components of the wound debridement system **1** may optionally comprise one or more elements of the additional therapeutic treatment system or vice versa. For example, in embodiments in which the wound debridement system **1** is used in conjunction with an additional therapeutic treatment system used to remove and/or deliver fluids to the tissue site (such as, e.g. a NPWT and/or instillation treatment system) the central post **47** may optionally be modified to include a channel through which the fluids of the adjunct treatments may be removed and/or delivered.

(90) In various embodiments, the additional therapeutic treatment system that the wound debridement system **1** is used in conjunction with may be a NPWT system. The use of the wound debridement system **1** with the NPWT system may improve the functioning of both systems, as the debridement of the debris **7** at the tissue site **5** may improve the efficacy of the NPWT treatment, while the negative pressure applied by the NPWT system may advantageously assist in removing the debris **7** that has been loosened and removed from the tissue site **5** by the wound debridement system **1**.

(91) In some embodiments, the wound debridement system **1** may be used in conjunction with an instillation therapy system. In such embodiments, a NPWT system may also optionally be included. The instillation therapy system may assist in the hydration and flushing of the tissue site **5**, which may facilitate the debridement of the debris **7** by the wound debridement system **1**. In turn, the wound debridement system **1** may allow for greater control of the instillation therapy system.

(92) More specifically, in some embodiments, the active layer **40** may be actuated by the drive unit **70** during the instillation fill, soak and removal phases of instillation therapy. During the fill phase, the actuation of the active layer **40** may encourage a thorough and uniform distribution of the instillation fluid at the tissue site **5** by the wound interface layer **10**. During the soak phase, the hydrating effect of the instillation fluid at the tissue site **5** may increase the debridement efficiency of wound interface layer **10**. Additionally, in some embodiments, the instillation fluid may optionally contain a topical solution that may assist in reducing patient discomfort during the debridement process. Finally, the flushing and fluid removal phase of the instillation therapy may encourage and assist in the removal of debrided debris **7** from the tissue site **5**.

(93) In some embodiments, the wound debridement system **1** may be used in conjunction with (either before, during or after) existing tissue removal and debridement systems and methods. For example, the wound debridement system **1** may be used prior to enzymatic debridement to soften the debris **7**. In another example, an existing mechanical debridement technique or method may be used to remove a portion of the debris **7** at the tissue site **5**, and the wound debridement system **1** may then be used to remove the remaining debris **7** while reducing the risk of trauma to the tissue site **5**.

(94) Although not shown, in some embodiments in which the wound debridement system **1** is used in conjunction with a NPWT and/or instillation therapy device, one or more of the transmission layers **45** forming the active layer **40** may optionally be formed as a hollow structure having one or more ports that are in fluid communication with a source of negative pressure and/or fluid that is provided via a

fluid channel formed through the central post **47**. In such a manner, the active layer **40** may optionally be used to both drive the wound interface layer **10** to debride the tissue site **5** and to assist in the distribute/remove fluids to/from the tissue site **5**.

CONFIGURATION OF EXEMPLARY EMBODIMENTS

(95) The construction and arrangement of the systems and methods as shown in the various exemplary embodiments are illustrative only. Although only a few embodiments have been described in detail in this disclosure, many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.). For example, the position of elements can be reversed or otherwise varied and the nature or number of discrete elements or positions can be altered or varied. Accordingly, all such modifications are intended to be included within the scope of the present disclosure. The order or sequence of any process or method steps can be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes, and omissions can be made in the design, operating conditions and arrangement of the exemplary embodiments without departing from the scope of the present disclosure.

Claims

1. An active debridement wound dressing comprising: a wound interface layer configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound; and an active layer coupled to the wound interface layer and comprising a transmission layer extending radially outwards relative to a central post, the transmission layer being configured to vibrate in response to a vibrational energy transmitted to the transmission layer by the central post so as to move the wound interface layer relative to the wound and mechanically debride the wound.
2. The active debridement wound dressing of claim 1, wherein the transmission layer is formed from a plurality of arm members.
3. The active debridement wound dressing of claim 2, wherein the plurality of arm members form an interconnected, interrupted planar structure.
4. The active debridement wound dressing of claim 1, wherein the wound interface layer is formed from a foam material.
5. The active debridement wound dressing of claim 4, wherein a plurality of through-holes extend through the wound interface layer, the plurality of through-holes being distinct from pores which define the foam material from which the wound interface layer is formed.
6. The active debridement wound dressing of claim 4, further comprising an absorbent layer, the absorbent layer being distinct and separate from the wound interface layer.
7. The active debridement wound dressing of claim 6, wherein the transmission layer is positioned on top of a top surface of the wound interface layer and below a lower surface of the absorbent layer.
8. The active debridement wound dressing of claim 1, wherein the transmission layer is at least partially embedded within the wound interface layer.
9. The active debridement wound dressing of claim 1, wherein the active layer comprises a plurality of vertically spaced transmission layers.
10. The active debridement wound dressing of claim 1, further comprising a drive unit configured to generate the vibrational energy operably attached to the central post.
11. The active debridement wound dressing of claim 1, further comprising a semi-rigid support layer positioned between a drape layer and the wound dressing, the support layer configured to prevent the wound dressing from sticking to the drape layer and to prevent the wound dressing from being

unintentionally displaced from a desired treatment area in response to a vibrational energy being applied to the wound dressing.

12. An active debridement wound dressing comprising: a wound interface layer configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound; and an active layer coupled to the wound interface layer and comprising a transmission layer extending radially outwards relative to a central post, the transmission layer being configured to rotate when activated so as to move the wound interface layer relative to the wound and mechanically debride the wound.

13. The active debridement wound dressing of claim 12, wherein the transmission layer is formed from a plurality of arm members.

14. The active debridement wound dressing of claim 12, wherein the wound interface layer is formed from a foam material.

15. The active debridement wound dressing of claim 12, wherein the transmission layer is at least partially embedded within the wound interface layer.

16. The active debridement wound dressing of claim 12, wherein the active layer comprises a plurality of vertically spaced transmission layers.

17. The active debridement wound dressing of claim 12, wherein the transmission layer is movably attached to the central post, such that the transmission layer may be rotated relative to the central post.

18. The active debridement wound dressing of claim 12, wherein the transmission layer is configured to rotate in an orbital motion.

19. A method of debriding a wound comprising: providing a dressing including a wound interface layer configured to contact a wound and mechanically debride the wound when the wound interface layer moves relative to the wound; providing an active layer coupled to the wound interface layer, the active layer comprising a transmission layer configured to transmit vibration or oscillation across the wound dressing; transmitting at least one of a vibrational or an oscillatory motion to the wound interface layer via the transmission layer; and rotating the transmission layer relative to a central post in response to the transmitted vibrational or oscillatory motion.

20. The method of claim 19, further comprising providing a therapy unit separate from the wound dressing, the therapy unit configured to generate and apply at least one of the vibrational or the oscillatory motion to the active layer.