



US 20170013886A1

(19) **United States**

(12) **Patent Application Publication**
TOWFIGH

(10) **Pub. No.: US 2017/0013886 A1**

(43) **Pub. Date: Jan. 19, 2017**

(54) **INTEGRATED SUPPORTIVE DEVICE IN GARMENTS**

A41D 1/08 (2006.01)

A41B 11/02 (2006.01)

(71) Applicant: **Hexagon Health, Inc.**, Beverly Hills, CA (US)

(52) **U.S. Cl.**
CPC . *A41C 1/10* (2013.01); *A41D 1/08* (2013.01);
A41B 11/02 (2013.01); *A41C 1/08* (2013.01);
A41B 1/06 (2013.01)

(72) Inventor: **Shirin TOWFIGH**, Beverly Hills, CA (US)

(21) Appl. No.: **15/201,259**

(22) Filed: **Jul. 1, 2016**

Related U.S. Application Data

(60) Provisional application No. 62/187,515, filed on Jul. 1, 2015.

Publication Classification

(51) **Int. Cl.**

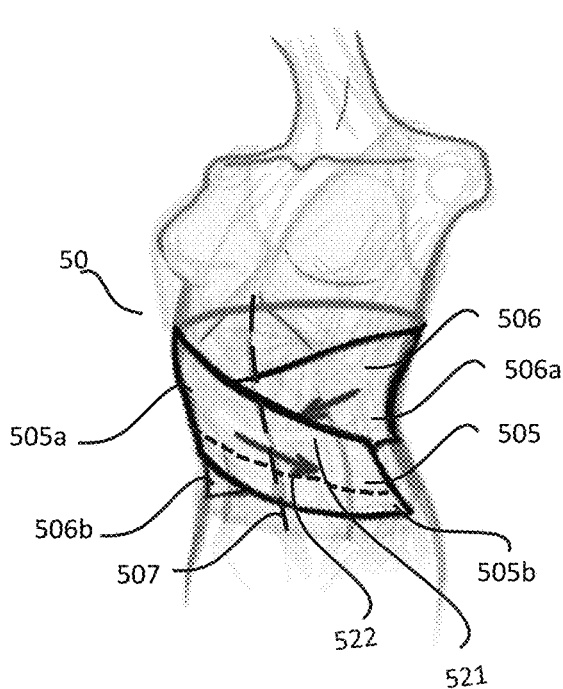
A41C 1/10 (2006.01)

A41B 1/06 (2006.01)

A41C 1/08 (2006.01)

(57) **ABSTRACT**

Disclosed herein is a device integrated in a piece of garment for providing abdominal support to a user comprising: an elastic band configured to wrap around a waist of the user and provide upward and inward physical support to an abdominal region of the user upon wearing; an interface configured to attach the elastic band to the piece of garment; at least one mechanically adjustable connection, wherein the mechanical adjustable connection is configured to adjust a length of the elastic band upon wearing; and an integration of the elastic band to the piece of garment, wherein the integration is configured to prevent at least a portion of the elastic band from directly contacting a body of the user upon wearing.



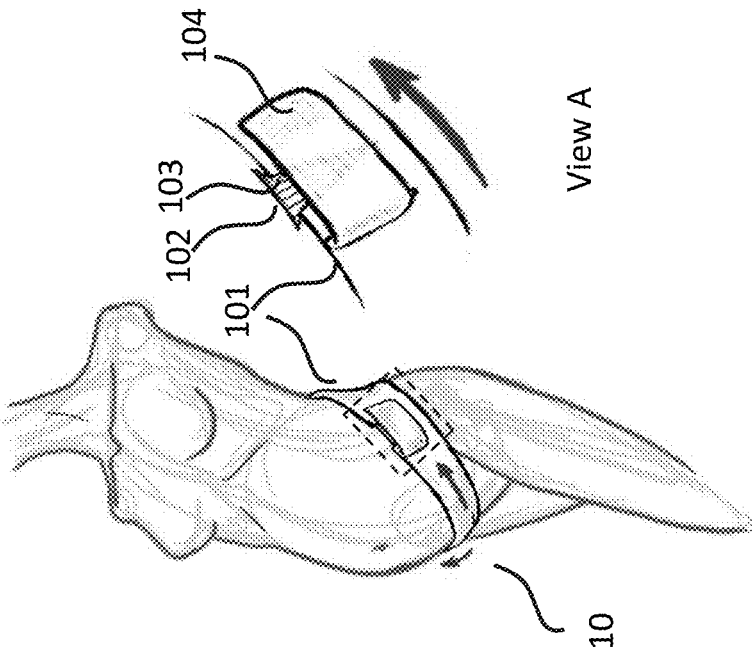


Fig. 1

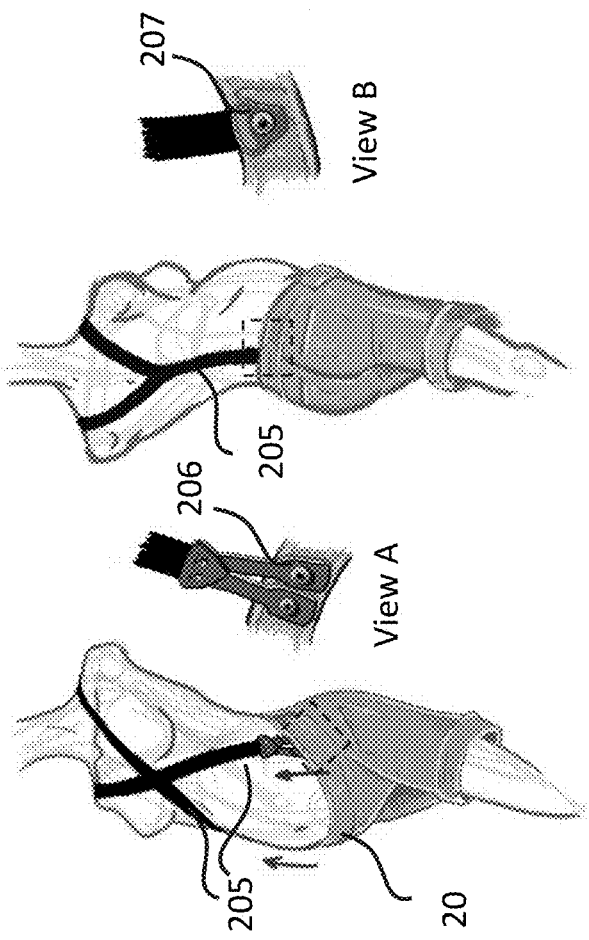


Fig. 2

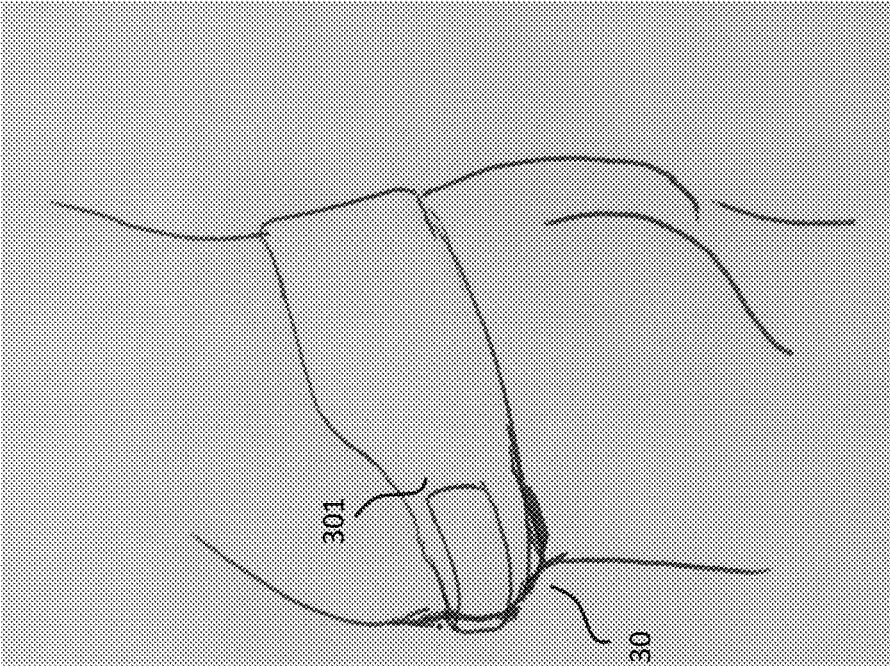


Fig. 3

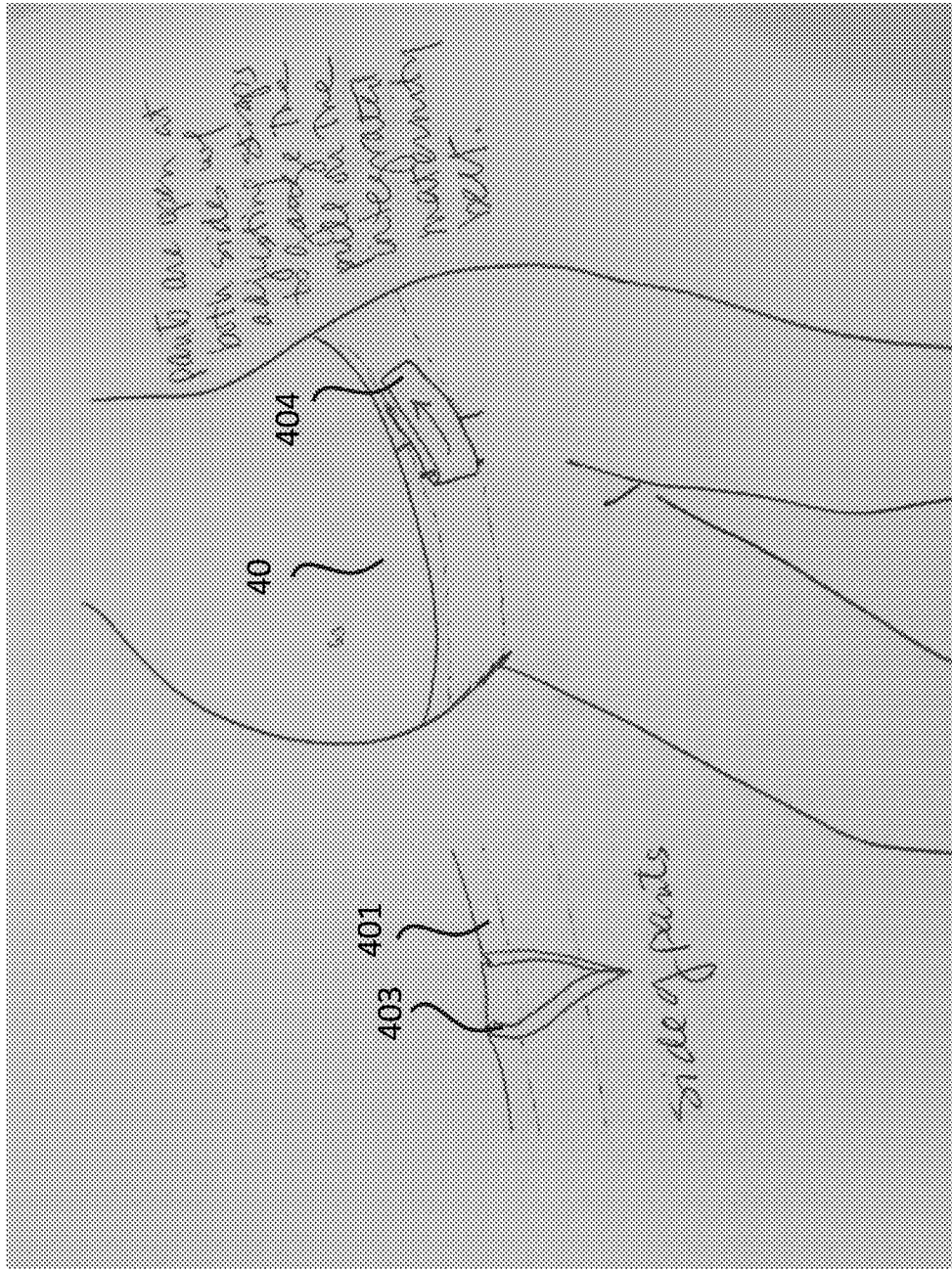


Fig. 4

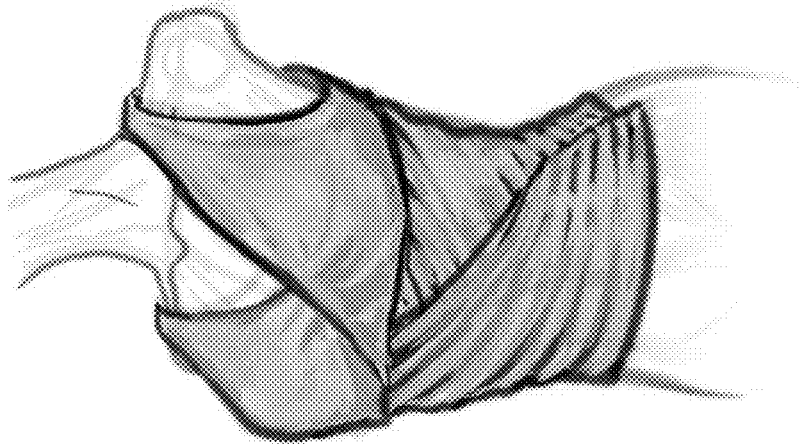
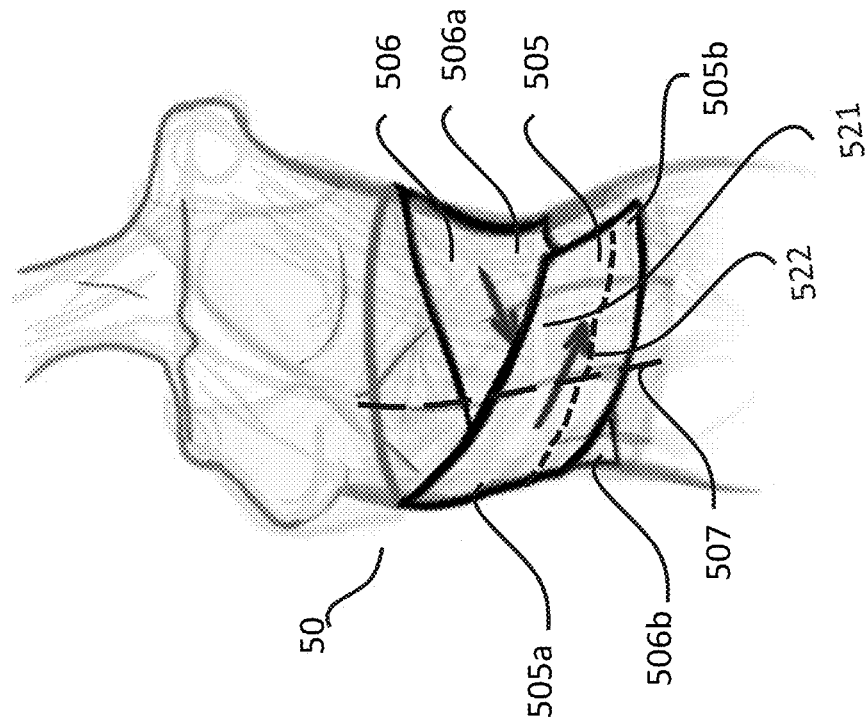


Fig. 5



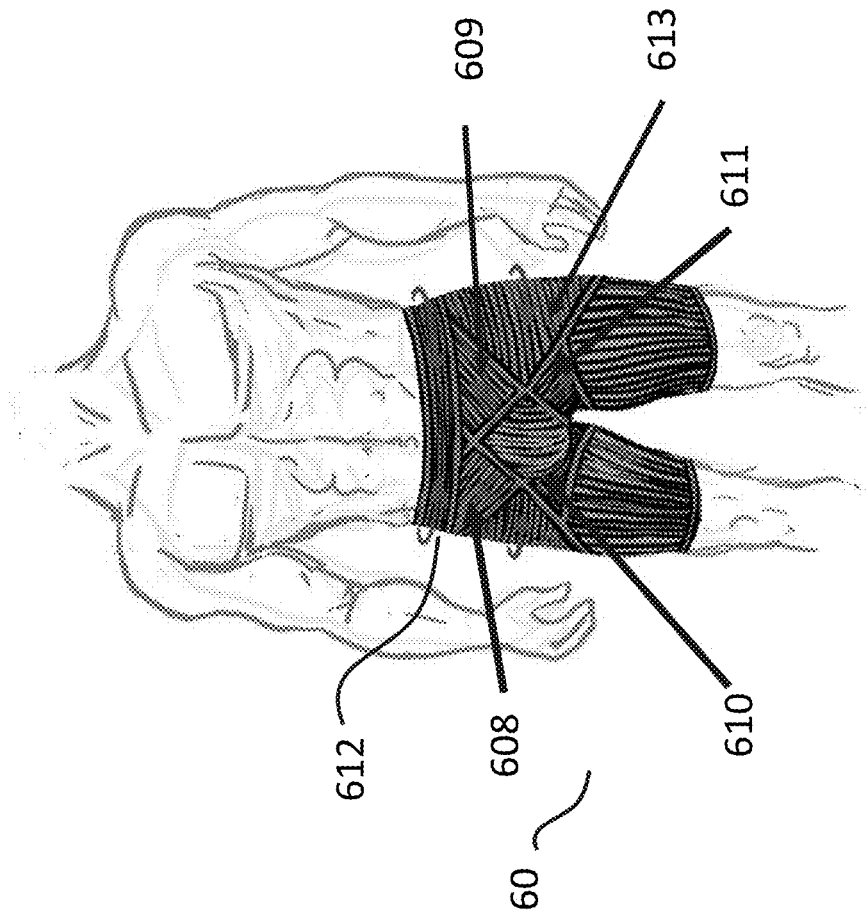


Fig. 6

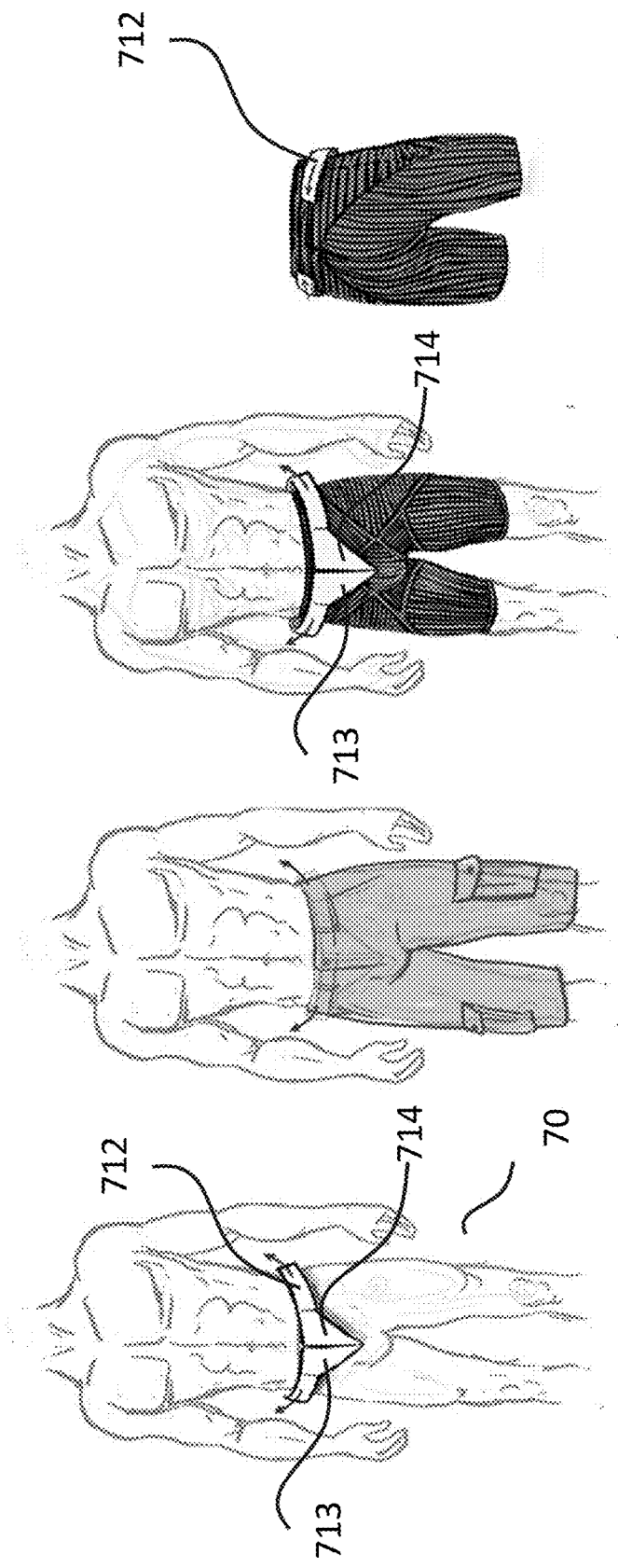


Fig. 7

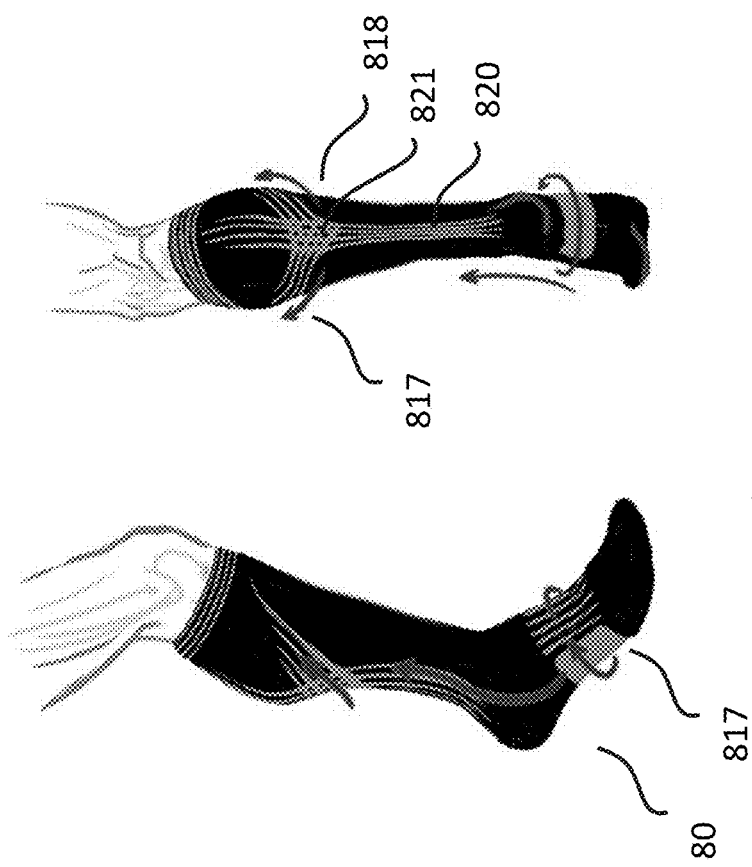


Fig. 8

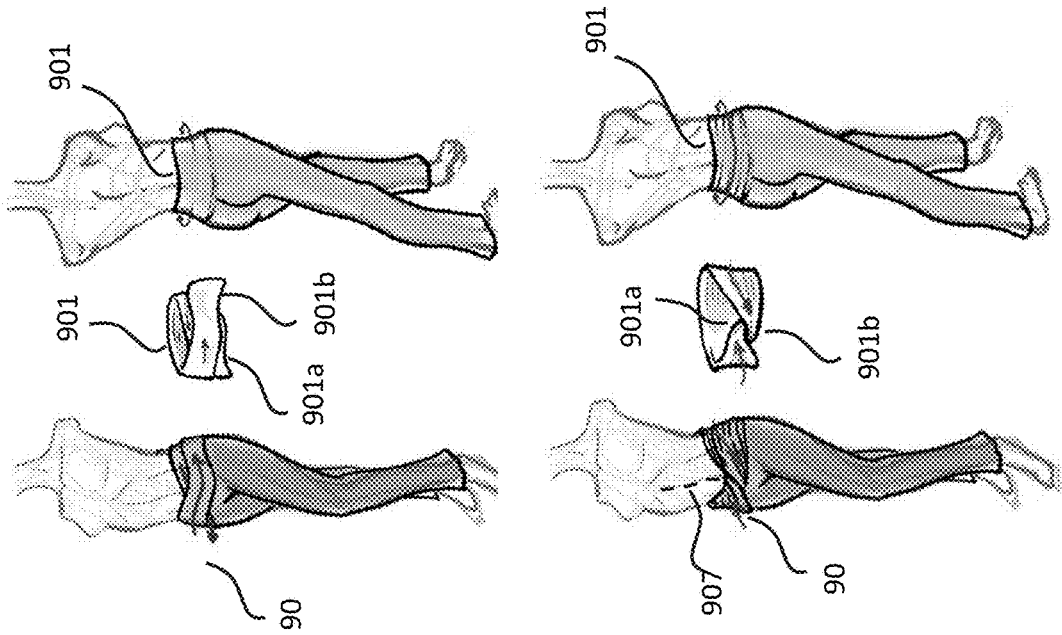


Fig. 9

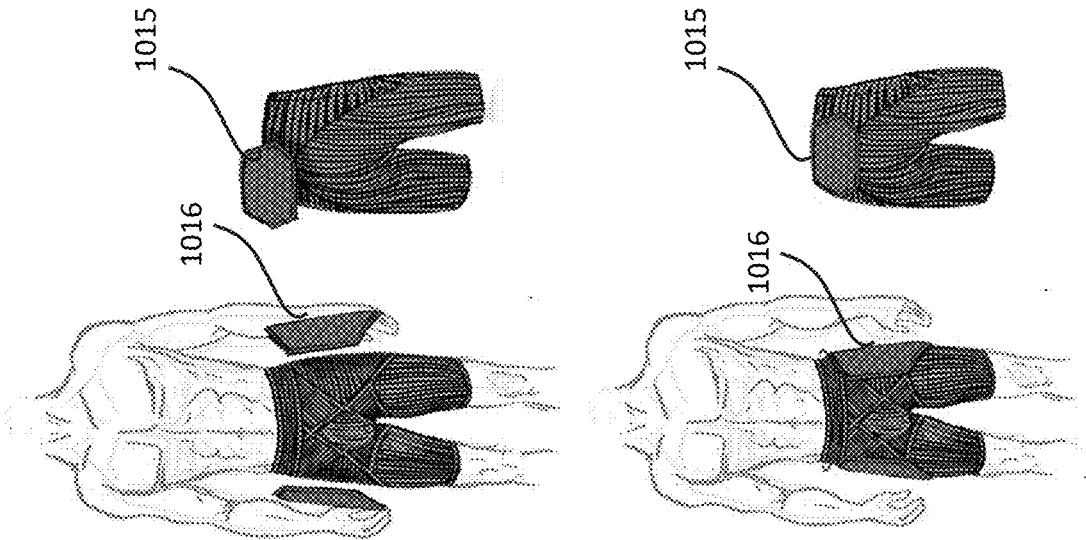


Fig. 10

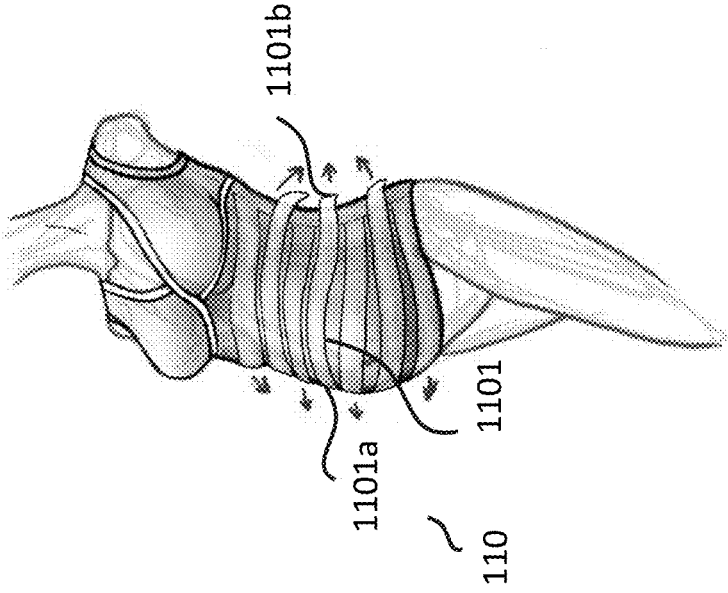
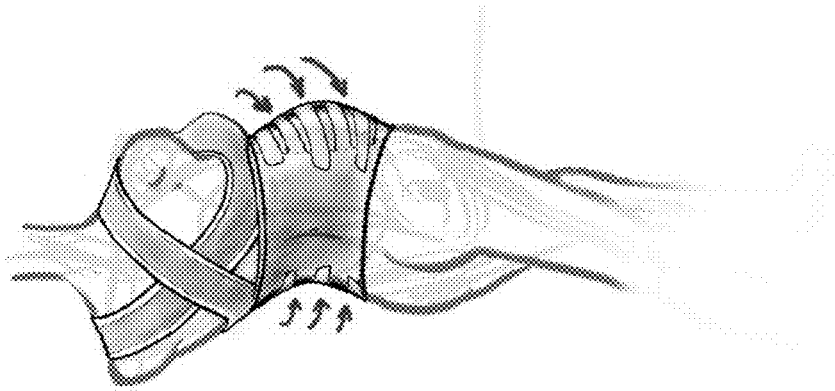


Fig. 11

INTEGRATED SUPPORTIVE DEVICE IN GARMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a non-provisional of, and claims the benefit of U.S. Provisional Application No. 62/187,515 entitled "integrated supportive device in garments" filed Jul. 1, 2015, the entire contents of which are incorporated herein by reference

BACKGROUND OF THE INVENTION

[0002] During pregnancy, a woman's abdomen will distend as the fetus grows and the uterus expands. As the abdominal distension and weight gain continues, discomfort and difficulty increases even in daily activities such as sleeping, walking, bending, or driving. Physical activities, especially sports activities, may be prone to induce and/or affected by different health conditions including sports hernia, groin strain, and Achilles tendon rupture

SUMMARY OF THE INVENTION

Field of the Invention

[0003] The present invention relates to supportive garment, protective garment, maternity support wear, postnatal support wear, performance protection and support wear.

[0004] During pregnancy, a woman's abdomen will distend as the fetus grows and the uterus expands. As the abdominal distention and weight gain continues, the gravid uterus applies downward and outward pressure onto the pelvic floor and the abdominal wall. This results in straining on the core muscles, the pelvis, and the pelvic organs. As a result, pregnant women are prone to a high incidence of: pelvic floor dysfunction in about 1/3 of women; low back pain and pelvic girdle pain in about 1/4 of women; and diastasis recti in about 2/3 of women. In addition, the gravid uterus places pressure on the lymphatic drainage from the lower extremities, resulting in painfully swollen feet, ankles, and legs. In the situation of high-risk pregnancy, the gravid uterus adds pressure on the cervix, which may lead to premature labor, especially among women with short cervix. In over half the women, postpartum long term effects of these pressures may result in complications that last after child-birth. These include urinary frequency, urgency, stress urinary incontinence, fecal incontinence, constipation, sexual complaints, abdominal distension, low back pain, skin stretch marks, and loose lower abdominal skin. The incidence of these problems increase with age at time of pregnancy and multiparity, both of which are increasing trends in the modern day.

[0005] Physical activities among both men and women may also apply stress and strain on the core muscles, which include the abdominal wall, pelvic floor, hips, diaphragm, and back muscles. As an example, sports activities may result in muscle or tendon strain that causes pain, such as with a sports hernia, hip labral tear, or Achilles tendon rupture. Jobs that result in heavy lifting and prolonged standing may result in low back pain, abdominal wall and groin hernia. Weight gain and heavy lifting may predispose one to diastasis recti. In some cases, the device disclosed herein includes a maternity support belt that is integrated into the garment for gravid uterus support, pelvic floor

support, and/or protection. In alternative case, the device disclosed herein includes a postnatal support belt that is integrated into the garment for abdominal wall support and/or compression. In certain embodiments, the device disclosed herein alternatively includes a sport performance support belt that is integrated into the garment for groin support, hip support, and/or core muscle support. In alternative embodiments, the device disclosed herein alternatively includes a lower extremity muscle and tendon support and/or compression for the foot and calf.

[0006] The device disclosed herein is different from loose maternity clothes, postnatal garments, or traditional sportswear. The device disclosed herein adds performance technology and support to the garments based on knowledge of anatomy, medical conditions, and surgical disease. In some cases, the device disclosed herein is configured to provide prevention of injury, including prevention of injury to the abdominal wall, pelvic floor, hip, and lower extremity muscles and tendons. The medical benefits of the device disclosed herein, includes reduced pressure on bladder, less urinary frequency, less back pain, less pressure on cervix, and thus increased likelihood to get to term and therefore less likely to have early labor in women with short cervix less pressure on top of legs, less pressure on lymphatics and therefore less leg swelling, less skin stretching and perhaps stretch marks, less muscle stretching and risk for diastasis of the muscles, and/or improved overall abdominal tone. The device disclosed herein is especially helpful for women with the second or any later pregnancy, as the abdomen and pelvis are already stretched from previous pregnancies and they tend to have less support, for multiparous pregnancy such as twins or triplets, and for working women who may need to be on their feet at work for long periods of time. Additionally, the advantages associated with the device disclosed herein includes alleviation of Diastasis Recti, reduced occurrence of sports induced hernia and/or groin strain, less occurrence of Achilles' tendon rupture, less calf swelling, prevention of skin chafing, less postnatal complication, alleviation of stretch marks, alleviation of urinary incontinence, alleviation of pelvic floor dysfunction, less back pain, improvement in posture, improved medialization of rectus muscles early postpartum, and improved hip stabilization. The benefit of integrating the device disclosed herein into clothing as opposed to wearing it separately, is that it is less likely to "ride" up or down as the body moves and thus it fits better to the body. Further, the integration of the device disclosed herein underneath a layer of clothing avoids direct contact with the skin, thus additionally reduces skin reaction, redness, chafing, or other discomfort. The integration of the device disclosed herein into a piece of a garment is removable, reversible, adjustable, and independent of the fabric, shape, or other properties of the garment.

[0007] In one aspect, disclosed herein is a device integrated in a piece of garment for providing abdominal support to a user comprising: an elastic band configured to wrap around a waist of the user and provide upward and inward physical support to an abdominal region of the user upon wearing; an interface configured to attach the elastic band to the piece of garment; at least one mechanically adjustable connection, wherein the mechanical adjustable connection is configured to adjust a length of the elastic band upon wearing; and an integration of the elastic band to the piece of garment, wherein the integration is configured to

prevent at least a portion of the elastic band from directly contacting a body of the user upon wearing.

[0008] In some cases, the band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the band comprises a width of about 1 cm to about 40 cm. In some cases, the band comprises a length of about 10 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around an abdominal region, when it is properly worn. In some cases, the abdominal region is below a waist. In some cases, the device further comprises a second interface configured to connect to a supporting strap. In some cases, the supporting strap is a shoulder strap. In some cases, location of the connection between the second interface and the supporting strap is adjustable. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a strap, a ring, a clip, a loop tape, a hook tape, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to a human body. In some cases, the integration is underneath a top layer of the piece of garment. In some cases, the piece of garment is a top, a bottom, or a piece comprising a top and a bottom. In some cases, the device as disclosed herein is configured to provide maternity support.

[0009] In another aspect, disclosed herein is a device integrated into a piece of garment for providing abdominal support to a user comprising: at least two elastic bands, wherein the at least two elastic bands are not substantially parallel to each other; an interface configured to attach the elastic bands to the piece of garment; at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection is configured to adjust a length of the elastic band, wherein the device is configured to provide abdominal support to the user, and wherein the device is integrated in the piece of garment such that at least a portion of the elastic band does not directly contact a body of the user upon wearing.

[0010] In some cases, each elastic band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the elastic band comprises a width of about 1 cm to about 40 cm. In some cases, the elastic band comprises a length of about 10 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around an abdominal region, when it is properly worn. In some cases, the abdominal region is below a waist, near a waist, or near a belly button. In some cases, the integration is underneath a top layer of the piece of garment. In some cases, the abdominal region is below breasts and substantially above a waist or a belly button. In some cases, the piece of garment is a top or a bottom. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a strap, a ring, a clip,

a hook take, a loop take, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to a human body. In some cases, the piece of garment comprises a top and a bottom. In some cases, the at least two elastic bands overlap partially with each other. In some cases, an acute angle between a longest dimension of each elastic band is between 10 degrees and 89 degrees, the acute angle being adjustable by a user. In some cases, the device disclosed herein is configured to provide postnatal support.

[0011] In yet another aspect, disclosed herein is a device integrated into a piece of garment for sport hernia support comprising: at least two elastic bands, the at least two elastic bands are not substantially parallel to each other; an interface configured to attach to the piece of garment; at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection is configured to adjust a length of the elastic band, wherein the device is configured to provide abdominal support, and wherein the device is integrated such that at least a portion of the elastic band does not make direct contact with a human body upon wearing.

[0012] In some cases, each elastic band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the elastic band comprises a width of about 1 cm to about 40 cm. In some cases, the elastic band comprises a length of about 2 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around at least part of an abdominal region, when it is properly worn. In some cases, the abdominal region is below a waist, near a waist, or below a belly button. In some cases, the piece of garment is a bottom or a top. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a hook tape, a loop tape, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to an area of a human body. In some cases, the at least two elastic bands overlap partially with each other. In some cases, a longest dimension of any two elastic bands intersects with an acute angle between 10 degrees and 89 degrees, the acute angle being adjustable. In some cases, the device as disclosed herein further comprises two additional elastic bands, the two additional elastic bands are elastic. In some cases, the device as disclosed herein is configured to provide sport hernia support, groin strain support, or sport hernia support and groin strain support.

[0013] In yet another aspect, disclosed herein is a device integrated into a piece of garment for compression support comprising: at least two elastic bands; an interface configured to attach to the piece of garment; at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection is configured to adjust a length of the elastic band, wherein the device is configured to provide compression support, and wherein the device is integrated such that at least a portion of the elastic band does not make direct contact with a human body upon wearing.

[0014] In some cases, each elastic band is elastic in three dimensions. In some cases, the interface is a mechanically

reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the elastic band comprises a width of about 1 mm to about 40 cm. In some cases, the elastic band comprises a length of about 2 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around a calf region, a foot, or a calf region and a foot, when it is properly worn. In some cases, the piece of garment is a sock. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a button, a hook, a loop, a tie, a hook tape, a loop take, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to an area of a human body. In some cases, the at least two elastic bands are not substantially parallel. In some cases, a longest dimension of any two elastic bands intersects with an acute angle between 10 degrees and 89 degrees, the acute angle being adjustable. In some cases, the device as disclosed herein further comprises two additional elastic bands, the two additional elastic bands are elastic. In some cases, the device as disclosed herein is configured to provide compression support for a calf, a foot, a leg, or a combination thereof. In some cases, the at least two elastic bands overlap partially with each other.

[0015] In an alternative aspect, disclosed herein is device integrated into a sock for mechanical support and compression comprising: a first elastic band at a foot portion of the sock; and a second and a third elastic band at a leg portion of the sock, wherein the second and the third elastic bands are not substantially parallel to each other and overlap at least partially with each other, wherein the first, second, and third elastic bands are integrated into the sock such that at least a portion of the elastic band does not make direct contact with a human body upon wearing, wherein the device is configured to provide compression and mechanical support to at least two muscles, at least one tendon, or both of a wearer.

[0016] In some cases, one or more of the first, second, or third elastic band is elastic in three dimensions. In some cases, the first, second, or third elastic band comprises a width of about 1 mm to about 4 cm in a relaxed state. In some cases, the elastic band comprises a length of about 1 cm to about 50 cm when the device is in a relaxed state. In some cases, the first, second, or third elastic band comprises a length that fits around a calf region, a forefoot, an arch, an Achilles' tendon region, or a combination thereof upon wearing. In some cases, the device is configured to prevent shifting of the first, second, and third elastic bands with respect to a lower leg and foot upon wearing. In some cases, a longest dimension of any two of the first, second, or third elastic bands intersects with an acute angle between 10 degrees and 89.9 degrees. In some cases, the acute angle is adjustable by a wearer. In some cases, the at least two muscles include a calf muscle, a soleus muscle, a gastrocnemius muscle, a plantaris muscle or a combination thereof. In some cases, the at least one tendon is the Achilles' tendon. In some cases, the first elastic band is substantially a closed loop wrapped around a part of a foot of a wearer. In some cases, the part is a forefoot, an arch, or a combination thereof. In some cases, at least one of the second and the

third elastic bands is not a closed loop. In some cases, the second and the third elastic bands intersect in a region higher than an Achilles' tendon region of the wearer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The novel features of the invention are set forth with particularity in the appended claims. A better understanding of the features and advantages of the present invention will be obtained by reference to the following detailed description that sets forth illustrative embodiments, in which the principles of the invention are utilized, and the accompanying drawings of which:

[0018] FIG. 1 shows a non-limiting example of a device described herein for maternity support and/or protection.

[0019] FIG. 2 shows another non-limiting example of a device described herein for maternity support and/or protection.

[0020] FIG. 3 shows another non-limiting example of a device described herein for maternity support and/or protection.

[0021] FIG. 4 shows a non-limiting example of a device described herein for maternity support and/or protection.

[0022] FIG. 5 shows a non-limiting example of a device described herein for postpartum support and/or protection.

[0023] FIG. 6 shows a non-limiting example of a device described herein for sport hernia and/or groin strain support and/or protection.

[0024] FIG. 7 shows a non-limiting example of a device described herein for sport hernia and/or groin strain support and/or protection.

[0025] FIG. 8 shows a non-limiting example of a device described herein for calf and foot compression and/or support.

[0026] FIG. 9 shows a non-limiting example of a device described herein for postpartum support and/or protection.

[0027] FIG. 10 shows a non-limiting example of a device described herein for sport hernia groin strain support and/or protection.

[0028] FIG. 11 shows a non-limiting example of a device described herein for maternity support and/or protection.

DETAILED DESCRIPTION OF THE INVENTION

[0029] During pregnancy, a woman's abdomen will distend as the fetus grows and the uterus expands. As the abdominal distention and weight gain continues, the gravid uterus applies downward and outward pressure onto the pelvic floor and the abdominal wall. This results in straining on the core muscles, the pelvis, and the pelvic organs. As a result, pregnant women are prone to a high incidence of: pelvic floor dysfunction in about 1/3 of women; low back pain and pelvic girdle pain in about 1/4 of women; and diastasis recti in about 2/3 of women. In addition, the gravid uterus places pressure on the lymphatic drainage from the lower extremities, resulting in painfully swollen feet, ankles, and legs. In the situation of high-risk pregnancy, the gravid uterus adds pressure on the cervix, which may lead to premature labor, especially among women with short cervix. In over half the women, postpartum long term effects of these pressures may result in complications that last after child-birth. These include urinary frequency, urgency, stress urinary incontinence, fecal incontinence, constipation, sexual complaints, abdominal distension, low back pain,

skin stretch marks, and loose lower abdominal skin. The incidence of these problems increase with age at time of pregnancy and multiparity, both of which are increasing trends in the modern day.

[0030] Physical activities among both men and women may also apply stress and strain on the core muscles, which include the abdominal wall, pelvic floor, hips, diaphragm, and back muscles. As an example, sports activities may result in muscle or tendon strain that causes pain, such as with a sports hernia, hip labral tear, or Achilles tendon rupture. Jobs that result in heavy lifting and prolonged standing may result in low back pain, abdominal wall and groin hernia. Weight gain and heavy lifting may predispose one to diastasis recti. In some cases, the device disclosed herein includes a maternity support belt that is integrated into the garment for gravid uterus support, pelvic floor support, and/or protection. In alternative case, the device disclosed herein includes a postnatal support belt that is integrated into the garment for abdominal wall support and/or compression. In certain embodiments, the device disclosed herein alternatively includes a sport performance support belt that is integrated into the garment for groin support, hip support, and/or core muscle support. In alternative embodiments, the device disclosed herein alternatively includes a lower extremity muscle and tendon support and/or compression for the foot and calf.

[0031] The device disclosed herein is different from loose maternity clothes, postnatal garments, or traditional sportswear. The device disclosed herein adds performance technology and support to the garments based on knowledge of anatomy, medical conditions, and surgical disease. In some cases, the device disclosed herein is configured to provide prevention of injury, including prevention of injury to the abdominal wall, pelvic floor, hip, and lower extremity muscles and tendons. The medical benefits of the device disclosed herein, includes reduced pressure on bladder, less urinary frequency, less back pain, less pressure on cervix, and thus increased likelihood to get to term and therefore less likely to have early labor in women with short cervix less pressure on top of legs, less pressure on lymphatics and therefore less leg swelling, less skin stretching and perhaps stretch marks, less muscle stretching and risk for diastasis of the muscles, and/or improved overall abdominal tone. The device disclosed herein is especially helpful for women with the second or any later pregnancy, as the abdomen and pelvis are already stretched from previous pregnancies and they tend to have less support, for multiparous pregnancy such as twins or triplets, and for working women who may need to be on their feet at work for long periods of time. Additionally, the advantages associated with the device disclosed herein includes alleviation of Diastasis Recti, reduced occurrence of sports induced hernia and/or groin strain, less occurrence of Achilles' tendon rupture, less calf swelling, prevention of skin chafing, less postnatal complication, alleviation of stretch marks, alleviation of urinary incontinence, alleviation of pelvic floor dysfunction, less back pain, improvement in posture, improved medialization of rectus muscles early postpartum, and improved hip stabilization. The benefit of integrating the device disclosed herein into clothing as opposed to wearing it separately, is that it is less likely to "ride" up or down as the body moves and thus it fits better to the body. Further, the integration of the device disclosed herein underneath a layer of clothing avoids direct contact with the skin, thus additionally reduces skin

reaction, redness, chafing, or other discomfort. The integration of the device disclosed herein into a piece of a garment is removable, reversible, adjustable, and independent of the fabric, shape, or other properties of the garment.

[0032] In one aspect, disclosed herein is a device integrated in a piece of garment for providing abdominal support to a user comprising: an elastic band configured to wrap around a waist of the user and provide upward and inward physical support to an abdominal region of the user upon wearing; an interface configured to attach the elastic band to the piece of garment; at least one mechanically adjustable connection, wherein the mechanical adjustable connection is configured to adjust a length of the elastic band upon wearing; and an integration of the elastic band to the piece of garment, wherein the integration is configured to prevent at least a portion of the elastic band from directly contacting a body of the user upon wearing.

[0033] In some cases, the band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the band comprises a width of about 1 cm to about 40 cm. In some cases, the band comprises a length of about 10 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around an abdominal region, when it is properly worn. In some cases, the abdominal region is below a waist. In some cases, the device further comprises a second interface configured to connect to a supporting strap. In some cases, the supporting strap is a shoulder strap. In some cases, location of the connection between the second interface and the supporting strap is adjustable. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a strap, a ring, a clip, a loop tape, a hook tape, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to a human body. In some cases, the integration is underneath a top layer of the piece of garment. In some cases, the piece of garment is a top, a bottom, or a piece comprising a top and a bottom. In some cases, the device as disclosed herein is configured to provide maternity support.

[0034] In another aspect, disclosed herein is a device integrated into a piece of garment for providing abdominal support to a user comprising: at least two elastic bands, wherein the at least two elastic bands are not substantially parallel to each other; an interface configured to attach the elastic bands to the piece of garment; at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection is configured to adjust a length of the elastic band, wherein the device is configured to provide abdominal support to the user, and wherein the device is integrated in the piece of garment such that at least a portion of the elastic band does not directly contact a body of the user upon wearing.

[0035] In some cases, each elastic band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close

to a peripheral side of the body when the device is properly worn. In some cases, the elastic band comprises a width of about 1 cm to about 40 cm. In some cases, the elastic band comprises a length of about 10 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around an abdominal region, when it is properly worn. In some cases, the abdominal region is below a waist, near a waist, or near a belly button. In some cases, the integration is underneath a top layer of the piece of garment. In some cases, the abdominal region is below breasts and substantially above a waist or a belly button. In some cases, the piece of garment is a top or a bottom. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a strap, a ring, a clip, a hook take, a loop take, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to a human body. In some cases, the piece of garment comprises a top and a bottom. In some cases, the at least two elastic bands overlap partially with each other. In some cases, an acute angle between a longest dimension of each elastic band is between 10 degrees and 89 degrees, the acute angle being adjustable by a user. In some cases, the device disclosed herein is configured to provide postnatal support.

[0036] In yet another aspect, disclosed herein is a device integrated into a piece of garment for sport hernia support comprising: at least two elastic bands, the at least two elastic bands are not substantially parallel to each other; an interface configured to attach to the piece of garment; at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection is configured to adjust a length of the elastic band, wherein the device is configured to provide abdominal support, and wherein the device is integrated such that at least a portion of the elastic band does not make direct contact with a human body upon wearing.

[0037] In some cases, each elastic band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the elastic band comprises a width of about 1 cm to about 40 cm. In some cases, the elastic band comprises a length of about 2 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around at least part of an abdominal region, when it is properly worn. In some cases, the abdominal region is below a waist, near a waist, or below a belly button. In some cases, the piece of garment is a bottom or a top. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a hook take, a loop take, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to an area of a human body. In some cases, the at least two elastic bands overlap partially with each other. In some cases, a longest dimension of any two elastic bands intersects with an acute angle between 10 degrees and 89 degrees, the acute angle being adjustable. In some cases, the device as disclosed herein further comprises two additional elastic bands, the two additional elastic bands

are elastic. In some cases, the device as disclosed herein is configured to provide sport hernia support, groin strain support, or sport hernia support and groin strain support.

[0038] In yet another aspect, disclosed herein is a device integrated into a piece of garment for compression support comprising: at least two elastic bands; an interface configured to attach to the piece of garment; at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection is configured to adjust a length of the elastic band, wherein the device is configured to provide compression support, and wherein the device is integrated such that at least a portion of the elastic band does not make direct contact with a human body upon wearing.

[0039] In some cases, each elastic band is elastic in three dimensions. In some cases, the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment. In some cases, the at least one mechanically reversible connection is close to a peripheral side of the body when the device is properly worn. In some cases, the elastic band comprises a width of about 1 mm to about 40 cm. In some cases, the elastic band comprises a length of about 2 cm to about 200 cm when the device is in a relaxed state. In some cases, the elastic band comprises a length that fits around a calf region, a foot, or a calf region and a foot, when it is properly worn. In some cases, the piece of garment is a sock. In some cases, the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a hook take, a loop take, an adhesive tape, or a combination thereof. In some cases, the piece of garment, the interface, or the piece of garment and the interface is configured to prevent shifting of the device with respect to an area of a human body. In some cases, the at least two elastic bands are not substantially parallel. In some cases, a longest dimension of any two elastic bands intersects with an acute angle between 10 degrees and 89 degrees, the acute angle being adjustable. In some cases, the device as disclosed herein further comprises two additional elastic bands, the two additional elastic bands are elastic. In some cases, the device as disclosed herein is configured to provide compression support for a calf, a foot, a leg, or a combination thereof. In some cases, the at least two elastic bands overlap partially with each other.

[0040] In an alternative aspect, disclosed herein is device integrated into a sock for mechanical support and compression comprising: a first elastic band at a foot portion of the sock; and a second and a third elastic band at a leg portion of the sock, wherein the second and the third elastic bands are not substantially parallel to each other and overlap at least partially with each other, wherein the first, second, and third elastic bands are integrated into the sock such that at least a portion of the elastic band does not make direct contact with a human body upon wearing, wherein the device is configured to provide compression and mechanical support to at least two muscles, at least one tendon, or both of a wearer.

[0041] In some cases, one or more of the first, second, or third elastic band is elastic in three dimensions. In some cases, the first, second, or third elastic band comprises a width of about 1 mm to about 4 cm in a relaxed state. In some cases, the elastic band comprises a length of about 1 cm to about 50 cm when the device is in a relaxed state. In some cases, the first, second, or third elastic band comprises a length that fits around a calf region, a forefoot, an arch, an

Achilles' tendon region, or a combination thereof upon wearing. In some cases, the device is configured to prevent shifting of the first, second, and third elastic bands with respect to a lower leg and foot upon wearing. In some cases, a longest dimension of any two of the first, second, or third elastic bands intersects with an acute angle between 10 degrees and 89.9 degrees. In some cases, the acute angle is adjustable by a wearer. In some cases, the at least two muscles include a calf muscle, a soleus muscle, a gastrocnemius muscle, a plantaris muscle or a combination thereof. In some cases, the at least one tendon is the Achilles' tendon. In some cases, the first elastic band is substantially a closed loop wrapped around a part of a foot of a wearer. In some cases, the part is a forefoot, an arch, or a combination thereof. In some cases, at least one of the second and the third elastic bands is not a closed loop. In some cases, the second and the third elastic bands intersect in a region higher than an Achilles' tendon region of the wearer.

[0042] In some cases, the device disclosed herein comprises a hidden low profile maternity belt integrated into a piece of garment. In some cases, the device disclosed herein comprises a hidden low profile postpartum wrap integrated into a piece of garment. In some cases, the device disclosed herein comprises a hidden low profile elastic band integrated into a piece of garment for support performance support, specifically designated to protect the user from sport hernia, groin strain, or Achilles's tendon rupture. In some embodiments, the device improves and facilitates the closure of Diastasis Recti and return of the wearer's figure. Such device is used for mothers after child delivery or regular people that suffer from Diastasis Recti. In some embodiments, the device includes unique side closures with at least one Velcro closure to cinch the lower belly up for support. In some case, the device includes foldable side gussets with lightweight pleated fabric to allow for easy in and out. In some case, the device includes attachable suspenders for extra-large bellies. In some embodiments, the device is applicable to any traditional bottoms, tops, underwear, or socks. In some embodiments, the piece of garment with the device integrated therein provides a smooth and a natural appearance as if the device is not integrated therein. Further, the garment with the device integrated therein is comfortable and convenient to wear.

Elastic Bands and Strips

[0043] In some case, the device disclosed herein includes one or more elastic bands. As disclosed herein, in some cases, the band may be a closed loop with its two ends connected to each other, or an elongate strip with two open ends. In alternative cases, the band may be a substantially closed loop with connection elements, (as a non-limiting example, FIGS. 1, 4, 6). In some cases, the elastic band includes a spatial direction that is longer than the other two spatial dimensions, and the length is along the longest spatial dimension of the elastic band in a relaxed, non-stretched state. In some cases, the length/longest dimension of the elastic band is along a line curved in a three dimensional space. As a nonlimiting example, a length/longest dimension of the elastic band is substantially the circumference of a loop shown as the belt 10 in FIG. 1. As a nonlimiting example, a length/longest dimension of the elastic band is substantially the length of line 522 shown as in FIG. 5. In some embodiments, the elastic band is wrapped so that the two ends along the longest spatial dimension of the strips

have at least some overlap upon wearing, for a nonlimiting example, FIG. 9. In alternative embodiments, two ends of the elastic bands along the longest dimension are not connected to each other upon wearing, for a nonlimiting example, FIGS. 5, 8. In further cases, the overlapping portion of the bands along the longest spatial directions is not connected to each other or not substantially parallel to each other upon wearing, for a nonlimiting example, FIG. 5. Such configuration of the overlapping portion is for increased flexibility and adjustment in providing customized support to the wearer. In some embodiments, the two ends and/or the overlapping portion along the longest spatial directions are Criss-crossed. The acute crossing angle therebetween is among about 10 to about 89 degrees. In alternative embodiments, two or more elastic bands are substantially parallel to each other, for a nonlimiting example, FIG. 11. In some cases, two or more elastic bands does not overlap with each other, for a nonlimiting example, FIG. 11.

[0044] In some embodiments, the elastic band is elastic in one, two, or three dimensions. In some embodiments, the elastic band is stretchable along its longest spatial dimension. In some cases, the elastic band shrinks along its second longest dimension and/or shortest dimension. In some case, the elastic band is equivalent to an elastic strip as disclosed herein. In some embodiments, the elastic band includes one or more elastic bands.

[0045] In some embodiments, each elastic band has a length and a width. In some embodiments, the length of the elastic band is along the longest dimension. As a nonlimiting example, the longest dimension may be a circumference of a loop, a length, or a diagonal. In some cases, the longest dimension may be curved in a three dimensional space. In alternative cases, a longest dimension may be at the relaxed and unstressed state of the elastic band/strip. In some case, the elastic band is an elastic strip. In some embodiments, each elastic band has a length or a width in between 5 mm to 200 cm. In some embodiments, the elastic band has a thickness that is smaller than its width and its length. In some embodiments, the elastic band has a thickness in between about 0.1 mm to about 5 cm.

[0046] In some embodiments, the device includes at least one, two, three, or four elastic bands. In alternative cases, the device includes an arbitrary number of elastic bands. In some embodiments, the device includes a wrap-around band comprising at least two elastic bands. In some embodiments, if the device includes more than one elastic band, the bands are not substantially parallel to each other. In further cases, the bands are in Criss-cross with an acute angle between at least 10 degrees to at least 89 degrees. In some embodiments, the bands overlap around the midline of the wearer's body to provide enhanced support in the overlapping region. In some embodiments, the elastic bands are aligned with targeted muscle groups. In some embodiments, the elastic bands stretch in direction of groin oblique muscles, and/or adductor muscles. In some embodiments, each elastic band stretches in direction substantially parallel or perpendicular to a muscle or a muscle group in order to optimize the support.

[0047] In some embodiments, the integration, the elastic bands, the shape of the elastic bands, the device, the portion of garment covering the device and the integration has minimal interruption to style and fashion of the garment. In some embodiments, the wrap-around feature of the elastic band functions as a fashion statement.

[0048] In some embodiments, the width of the elastic band is consistent along its length. In some embodiments, the width of the elastic band varies in order to optimize the comfort and amount of support for different part of the wearer's body. As a non-limiting example, the elastic band is thicker at the back to provide amble back support when it is properly worn.

[0049] Referring to FIG. 3, in a particular embodiment, an elastic band is properly worn around the waist. The garment that the device is integrated within is not shown. In this case, the elastic band is adjustable at a location other than a peripheral side of the wearer to provide appropriate amount of support with the adjusted waist size. The elastic band is wide enough to also enable back support of the wearer.

[0050] In some embodiments, the elastic band or the elastic band includes the maximal support/protection in a direction that is substantially perpendicular to the length of the band or strip. In some cases, the elastic stretching occurs mostly along the length of the band or strip. In some cases, the elastic shortening occurs mostly along the length of the band or strip. In some cases, the elastic stretching occurs mostly along the width of the band or strip. In some cases, the elastic shortening occurs mostly along the width of the band or strip.

Interfaces

[0051] In some embodiments, the device disclosed herein includes an interface or use of the same. In some cases, the interface includes a fastener element and/or an adjustment element. In further cases, the interface provides connection of the device to a piece of garment. In some embodiments, the interface connects directly to the complimentary interface of the piece of garment. In some cases, the interface and the complimentary interface enables fastening of the device to a certain location of the piece of garment. In some embodiments, the interface and the complimentary interface enables fastening of the device to a part of the wearer's body. In some embodiments, the interface and the complimentary interface enables fastening of the device to a part of the human body so that it ensures the support and protection during physical activities, for preventing activity associated injury or damages to the wearer's body. In some embodiments, the interface and the complimentary interface allows adjustment of the length, width, wrapping, the Criss-cross angle with another strip or band, the overlap area with another strip or band, the orientation of the elastic strip, the orientation of the elastic band, the elastic property of at least one elastic band.

[0052] In some embodiments, an interface, a complementary interface, or use of the same is installed to a traditional piece of garment to enable integration of the device disclosed herein. In some embodiments, the interface, the complimentary interface, or user of the same is removed so that a device integrated in a piece of garment is removed. In some embodiments, the connection between the interface and the complimentary interface is removed so that a device integrated in a piece of garment is removed.

Integration

[0053] In some cases, the device disclosed herein is integrated into a piece of garment. In some embodiments, the integration provides one or more advantages selected from: avoid direct skin contact, protection of the user's skin and/or

body damages caused by direction contact or friction with the device, prevent damage of the device caused by direct contact or friction with the user's body, and prevention of undesired shifting of the device with respect to a certain part of the user's body caused by wearing the device as a stand-alone device.

[0054] In some embodiments, the device disclosed herein is integrated into a piece of garment using one or more selected from: sewing, a belt, a buckle, a zipper, a tie, a Velcro attachment, a hook, a snap, an eye, a loop, a button, a clip, a hook tape, a loop tape, an adhesive tape, and a clasp. In some embodiments, the integration is permanent. In some embodiments, the integration is reversible. In some embodiments, the integration is through a reversible attachment to a piece of garment via at least one interface. In some embodiments, the interface fits to a complementary interface of the garment to form the attachment. In some embodiments, the interface is not in direct contact with any part of the wearer's body when the device is properly worn. In some embodiments, the interface includes a module design so that the device is attachable to multiple pieces of garment through the attachment to different complimentary interfaces of different garments.

[0055] In some embodiments, the device, the interface, the integration, or a combination thereof is hidden beneath a piece of clothing so that it is not directly visually identifiable when it is properly worn. In some embodiments, the device, the interface, the integration, or a combination thereof is sufficiently concealed underneath the top layer of the garment of integration. In some embodiments, the device, the interface, the integration, or a combination thereof is hidden above a piece of clothing so that it is not directly contacting the user's body when it is properly worn.

[0056] In some embodiments, one or more devices are integrated into one or more pieces of garment that can be worn simultaneously to provide independent support of one or more regions of the wearer's body.

[0057] In some cases, the device is integrated below the upper edge of the bottom. In some case, the device is integrated near the upper portion of the bottom. In some embodiments, the device is integrated below the breast region of a top. In some embodiments, the device is integrated above the lower edge of a top.

[0058] In some cases, the device is integrated in a piece of garment so that it is part of the garment. As a non-limiting example, the device is sewed in a piece of garment like the elastic waist band of an active bottom.

Adjustments

[0059] In some cases, one or more property of the device is user adjustable. In some cases, the length of the device is user adjustable using a closure located close to the midline or the peripheral side of the wearer's body. In some embodiments, the closure uses one or more selected from belt, a buckle, a zipper, a tie, a Velcro attachment, a hook, a snap, an eye, a loop, a button, a clip, a hook tape, a loop take, an adhesive tape, and a clasp.

[0060] In some embodiments, the amount of wrapping is adjustable, as weight and waist changes during pregnancy or postpartum. In some embodiments, the adjustment and proper wearing of the device helps promote closure of Diastasis Recti and return of the mother's figure.

[0061] In some embodiments, the adjustment of the device is associated with or dependent upon the adjustment of the

piece of garment covering it. In other cases, the adjustment of the device is independent of the adjustment of the piece of garment covering it.

[0062] Referring to FIG. 1, in a particular embodiment, a hidden belt **10** including elastic band **101** may be integrated to a pair of pants, a piece of top, or a garment including a waist area (for a nonlimiting example, a jumpsuit or a dress) (not shown) near the waist of the garment. The belt may provide abdominal support to the wearer. In this case, the elastic band may include an adjustable connection **102** optionally at the left or the right side of the pants. The adjustable connection **102** may allow adjustment of the total length of the elastic band as well as may ensure appropriate amount of support at various adjusted waist sizes. The adjustable connection may include an extendable unit **103** and a fastening unit **104**. The extendable unit may optionally be made of a less elastic material than the elastic band. Such extendable unit may render less resistance in extending the belt to a desired waist size. In some embodiments, the belt **10** sits lower on the waist at the front than at the back of the user, and such difference at the front and the back is user adjustable so as to provide personalized comfort and optimal support for different users or a single user at different stage of pregnancy. In this case, the width of the belt may be optionally uniform or variable at different locations. The length of the elastic band is the circumference of the belt.

[0063] Referring to FIG. 4, in a particular embodiment, a hidden belt **40** may be integrated into a pair of pants, a piece of top, or a garment including a waist area (for a nonlimiting example, a jumpsuit or a dress) (not shown) around the waist area for abdominal support. The elastic band **401** may be adjustable along with the waist of the garment at both peripheral sides via an adjustable connection **103**, **104** to gauge the pull on the integrated device.

[0064] Referring to FIG. 2, in a particular embodiment, a pair of pants, a piece of top, or a garment including a waist area (for a nonlimiting example, a jumpsuit or a dress) (not shown) include a hidden belt **20** including an elastic band **201** near its waist area. In the same case, the pants may further include one or more shoulder straps **205** for support of the belly in addition to the support of the belt. In this case, the shoulder straps may be optionally located at a user selected position of the waist to provide comfort, support, and convenience to the users. The shoulder strap may include a connection **205** on the front side and/or a connection **206** on the back side of the wearer to mechanically connect with the hidden belt. The connection may not directly contact the body of the wearer for optimized comfort and safety. In this case, the belt **20** may be hidden underneath the pants. The shoulder straps may be optionally located to avoid pressing on the breasts of the wearer.

[0065] FIG. 3 shows a side view of the belt **30** as disclosed herein which may include an elastic band **301** with non-uniform width (along the head-to-foot direction of the wearer). The piece of garment is not shown. The elastic band may be wider at the back of the user and narrower at the front side of the user. Such wider back side may provide sufficient support and distribute the same amount of force over a larger area thus may exert less pressure to the back of the wearer for providing the same abdominal support. The front side may be narrower to avoid bending of the elastic band along its width. The narrower front side may be advantageous to avoid covering and pressing of undesired areas. As a nonlimiting example, the narrower front side of

the elastic band may be worn below the waist line and below the belly to provide upward and/or inward support to the wearer. Keeping the belt narrow at the front may help avoid pressing the pregnant belly of the wearer and the organs and the baby therewithin.

[0066] The belt **10**, **20**, **30**, and **40** may include one or more mechanically adjustable connections **102**, **103**, **104**, **403**, and **404** that is configured to adjust the length of the elastic band. Such adjustment may at the same time affect the level of support that the elastic band may be able to provide to the user. In some cases, the adjustable connection **102** may include two or more structural elements. The structural element may include a fabric with adjustable length **103**, a fastening or locking element **104** that may lock the fabric at a user selected length. The locking element may include but may not be limited to a latch, a hook, a loop, a button, a zip, a button hole, a hook tape, a loop tape, an adhesive tape, or the like. In some cases, the mechanical adjustable connection may be positioned on one or both side of the wearer to increase comfort and convenience. The connection located on a side or both side(s) may be advantages as it may be more accessible to the wearer. The belt may be adjustable to provide abdominal support to users at different stage of pregnancy and/or with different belly sizes. In some cases, the connection includes a locking element **104** that is configured to enable pulling from the front to the back of wearer. Such configuration more ergonomic and provides less undesired impact and better support for the pelvis than pulling back to front or along other directions.

[0067] The belt **10**, **20**, **30**, and **40** may include a mechanical interface that allows attachment of the belt to a piece of bottom. The mechanical interface may be reversibly mounted to the garment. When the belt is not needed, the mechanical interface may be removed from the piece of garment depending on the need of the wearer. It may reduce weight of the garment, avoid wear and tear to the mechanical interface, and enable more flexibility to suit different users. Further, a reversible mechanical interface may be mounted to different pieces of garment to enable wearing of the same belt or different belt with different clothing options. Alternatively, the mechanical interface may be permanently mounted to the garment. Such permanent mounting may ensure easier, faster, safer, and more reliable attachment of the belt to the piece of garment. The permanent mounting of the interface may be less prone to accidental breakage or falling of the interface. The mechanical interface may be configured to provide a reversible attachment of the belt to the piece of garment so that the belt may be attached to or removed from the pants conveniently by the wearer. The garment may be worn together with or independent of the belt. Further, the mechanical interface may be hidden within the piece of garment along with the belt such that they are not directly contacting the body of the wearer. In addition, the mechanical interface may be hidden within the piece of garment along with the belt such that they are not exposed to an external environment. A hidden belt with hidden interface may provide significant comfort to the wearer as they may move along with the piece of garment relative to the body as a single unit. In addition, the belt and interface with no direct contact to the human body may alleviate the strict requirements on fabric of making as they may present much less or minimal health threats to the human body. For nonlimiting example, no direct contact may help avoid or reduce skin rashes due to friction, allergy to the fabric,

overheating the skin by the fabric, low breathability of the fabric, or the like. It may also reduce the cost of fabric in making the belt and/or interface. Further, a belt with interface not visible from outside may also provide high cosmetic values to the pieces of garment.

[0068] The belt **10**, **20**, **30**, and **40** may be integrated in a way that a part or the entirety of the elastic band does not directly contact a human body when the belt is worn properly. The integration may include two separate layers of the garment that covers the elastic band on one or both sides of the elastic band. The integration may be a fabric pocket with one or two openings that may allow sliding of the elastic band in or out of the pocket. The integration may alternatively be a sleeve of the elastic band. The integration may be padding or cushion customized to fit at least a portion of the inner side of the elastic band. As a nonlimiting example, a belt may be sandwiched by two fabric layers of the garment and mechanically attached to the garment. As another example, the belt may include a cover of the elastic band, the cover being between the elastic band and the body when the belt is worn underneath the garment. No direct contact with the user body may be advantageous. A belt with no direct contact with a wearer's body may provide significant comfort to the wearer as they may move along with the piece of garment relative to the body as a single unit. In addition, the belt with no direct contact to the human body may alleviate the strict requirements on fabric of making as they may present much less or minimal health threats to the human body. For nonlimiting example, no direct contact to the belt may help avoid or reduce skin rashes due to friction, allergy to the belt fabric, overheating the skin by the belt fabric, low breathability of the belt fabric, or the like. It may also reduce the cost of belt fabric in its making. Further, a belt not visible from outside may also provide high cosmetic values to the pieces of garment.

[0069] The belt **10**, **20**, **30**, and **40** may provide abdominal support to users of different body sizes and/or body shapes. The belt may be adjustable to provide abdominal support to users at different stage of pregnancy and/or with different belly sizes. As can be seen in FIGS. **1-4**, the belt may be worn such that the front side of the belt is below the waistline and the belly button while the back side of the belt may be worn higher than the front side of the belt. The belt may provide upward and/or inward abdominal support to the wearer. The abdominal region and its weight may push the band to elastically extend, while the belt may provide support in a direction that is against the pushing forces/pressures that exists in specific areas. The abdominal support at different site of the abdominal region may be different in its value or its direction. The belt may provide abdominal support such that weight and pressure to abdominal region may be partially or completely reduced by support from the back. In other words, the band may lift the abdominal region upward and inward by adding abdominal weight to the back via the elastic band. Thus, the belt may be wider on its back side to reduce pressure in unit area of the wearer's back underneath the band. The belt may also be higher on its back side to securely stabilize the belt when the abdominal region may have a tendency of stretching the belt downward and outward, especially in combination with motion of the wearer.

[0070] Referring to FIG. **9**, in a particular embodiment, a bottom may include a hidden device **90** comprising one elastic band **901** that may be crossed close to or at its two

open ends **901a**, **901b**. In this case, the hidden device with the crossed elastic band may provide support postpartum to promote closure of Diastasis Recti. The elastic band may have a size (stretched or relaxed) that may be sufficient to allow it to wrap around a waist area of a user and also have two open ends crossed securely. The two open ends of the elastic band may be crossed in customized manners that optimally provide support with comfort to the wearer. Optionally, the hidden device may include a mechanical fasten element (not shown, see **104**, **404**) that may fasten the two crossed ends of the elastic band. The elastic band may be hidden underneath the top layer of the bottom. Alternatively, the elastic band may be enclosed within a fabric layer sleeve. Optionally, the elastic band may overlap or cross near the midline **907** of the wearer. Such overlapping or cross may enable optimal support around the Diastasis Recti of the wearer. The elastic band may not overlap or cross on the back of the wearer. In some embodiment, the particular wrapping and overlapping style of the bottom is user adjusted to maximize individualized comfort and support. In the same case, the bottom optionally provides multiple wrapping options thus multiple style options to adjust to different weight, waist, body figure, and/or user demands. The elastic band may be worn lower than the waist line or the belly button. The elastic band may be wider on the back of the wearer.

[0071] Referring to FIG. **5**, in a particular embodiment, a top and optionally a matching bottom (FIG. **9**) may each include a hidden device **50**. The hidden device may include two Criss-crossed elastic bands **506**, **507**. The Criss-crossed bands may provide support postpartum to promote closure of Diastasis Recti. Each elastic band may have a length, (either stretched or relaxed) that is sufficient to cover a part or the entire front side of a wearer. Each elastic band may have a length **522** that is sufficient to cover a part or the entire front side of a wearer. The elastic bands may overlap, or intersect with an angle with each other near the midline **507** of the user in a region **521**. The elastic bands may be hidden underneath the top layer of the top. The elastic bands may be integrated to the top via an interface (not shown). The length of the Criss-crossed bands may be adjustable to enable optimal support for patients with different body shape and body sizes with comfort. The crossed band may be attached to each other at their overlapping area via a mechanical connection. Alternatively, the crossed band may not be attached to each other at their overlapping area to enable optimal flexibility in wrapping and fastening each elastic band independently. Further, not attaching the overlapping areas to each other may enable customized support to meet need for different users. Each crossed band may be attached to the top at its one end **505a**, **506a** or both its ends **505a**, **505b**, **506a**, **506b** via one or more mechanical connections. The mechanical connection may or may not be adjustable or reversible. The mechanical connection may include two collaborating elements. Nonlimiting examples of the mechanical connection may include one or more selected from a latch, a hook, a loop, a button, a zip, a button hole, a hook tape, a loop tape, an adhesive tape, or the like.

[0072] As disclosed in FIG. **5**, in some cases, the mechanical support provided by the devices disclosed herein from elastic band(s) is part of an everyday garment such as a top, a legging, or pair of pants, a camisole, or the like. In some cases, the device is not a separate belt worn under a piece of garment that can scratch and erode the skin. Additionally, the

device is not a piece of loose maternity outfit. In certain embodiments, the device integrated into a daily outfit is more accessible to pregnant women than stand-alone maternity belts. Further, the device integrated into a daily outfit is easier to wear than maternity belts, which can be inappropriately placed.

[0073] Referring to FIG. 11, in a particular embodiment, a base layer top may include a hidden device 110 with a plurality of hidden elastic bands 1101 below the breasts and around the abdominal region. The hidden elastic bands may be substantially parallel to each other with or without different fabric or material sewed in between them. In some cases, the hidden elastic bands do not overlap with each other. In some embodiments, each elastic band wraps about the wearer not in a closed loop such that the two ends along the longest dimension of each elastic band does not connect or overlap with each other. In other embodiments, each elastic band wraps around the wearer in a closed loop with or without a connection element to connect the two ends along the longest dimension. The elastic band along with the waist of the top is adjustable at the side of the top to provide appropriate amount of support for different body sizes and/or body shapes. One end 1101a of one or more elastic bands may be attached to a side of the top with non-adjustable attachment. Alternatively, one end 1101b of one or more elastic bands may be attached to a side of the top with an adjustable attachment. Such attachment may be reversible to increase flexibility in wearing the elastic bands. As an example, a wearer in need of stomach support may remove elastic bands beneath the lowest tip of her stomach via the reversible attachment and only wear the rest of the elastic bands. As another example, the wearer in need of stomach support may increase length of elastic bands beneath her stomach via the adjustable end 1101b to decrease support amount in certain areas. One or more elastic bands may sit lower on the waist at the front than at the back of the user, and such difference at the front and the back is user adjustable so as to provide personalized comfort and optimal support for different users or a single user at different stage of pregnancy. In this case, the width of each band is uniform or non-uniform at different locations. The adjustable attachment at one or both end of the elastic bands 1101a, 1101b may be similar to the mechanically adjustable connections 102, 103, 104, 403, and 404. The adjustable attachment at one or both end of the elastic bands 1101a, 1101b may include two collaborating elements. Nonlimiting examples of the mechanical connection may include one or more selected from a latch, a hook, a loop, a button, a zip, a button hole, a hook tape, a loop tape, an adhesive tape, or the like.

Support and Protection

[0074] In some embodiments, the device comprises one or more metal plates for additional weight support. In some embodiments, the device comprises one or more uplifting straps 101, 201, 301, 401, 501, 901, 1101 for additional weight support. In some embodiments, the device disclosed herein provides support for one or more selected from: an abdominal region, a belly, a stomach, a back, a lower back, a calf, a foot, a breast, and a waist. In some embodiments, the device provides one or more selected from: maternity support, abdominal support, rectus muscle support, nursing breast support, postpartum support, sport hernia support,

groin strain support, calf support, calf compression, foot compression, and abdominal compression.

[0075] In some embodiments, the device is worn below the breasts. In some cases, the device is worn above the waist. In some case, the device is worn below the waist or the belly button. In some embodiments, the device is worn around the waist or the belly button. In some case, the device is worn around the torso. In some embodiments, the device is worn near the Achilles tendon. In some embodiments, the device is worn around the arch of the foot, and or near the peripheral sides of a calf.

[0076] FIG. 6 shows an exemplary embodiment of a hidden device 60 as disclosed herein in an activity bottom. The hidden device may include at least five elastic bands 608, 609, 610, 611, 612. The hidden device may include four elastic bands 608, 609, 610, 611 optionally aligned in direction of groin oblique muscles (608, 609, 610, 611), and/or adductor muscles (608, 609, 610, 611) The hidden device may include one elastic band 612 that may optionally wrap around the waist. The hidden device may include one elastic band 613 to add additional support for muscles. The alignment of elastic bands with specific muscles may facilitate band stretching to maximize protection and support for sport hernia and/or groin strain. In the same embodiment, zone-specific stretch provided by the device is along direction of oblique muscles, adductor muscles, and hip stabilizers. Optional pads may be added for protection from fall injury to hip and/or coccyx.

[0077] Referring to FIG. 7, in a particular embodiment, an activity bottom is integrated with a hidden device 70 which may include three elastic bands 712, 713, 714. The device may include one elastic band 712 that optionally wraps around the waist. The device may include two bands optionally aligned in direction of groin muscles, and/or adductor muscles, 713, 714. The alignment of elastic bands with specific muscles may facilitate band stretching to maximize protection and support for sport hernia and/or groin strain. In some cases, the device 70 is integrated on top of the device 60 of FIG. 6 into the same or a different piece of garment such that it may provide comprehensive support and protection with the functionalities of each individual device (two right most panels). In alternative cases, the device 70 is integrated in a regular bottom (second panel to the left) along without the device 60. In some cases, device 60 and 70 alone or in combination may provide support to those with existing hernias, strain, or sports injury. In some cases, device 60 and 70 alone or in combination may optionally provide support to prevent possible hernia, strain or sports injuries.

[0078] The hidden device 60, 70 may be weaved into the activity bottom. Alternatively, the hidden device may be reversibly attached to the bottom via a mechanical interface in device 10, 20, 30, and 40. At least a portion or the entirety of the hidden device may not directly contact the body of the wearer.

[0079] The device 60, 70 may be integrated in a way that a part or the entirety of the elastic band does not directly contact a human body when the device and/or the garment it attaches thereto is worn properly. The integration may include two separate layers of the garment that covers the elastic band(s) on one or both sides of the elastic band(s). The integration may be a fabric pocket with one or two openings that may allow sliding of the elastic band(s) separately or together in or out of the pocket. The integration

may alternatively be a sleeve of one or more elastic bands. The integration may be padding or cushion customized to fit at least a portion of the inner side of the elastic band (s). As a nonlimiting example, a device may be sandwiched by two fabric layers of an active short and mechanically attached to the garment. As another example, the device may include a cover for each of the elastic band(s) or the elastic bands together. The cover may be between the elastic band(s) and the body when the device is worn underneath the garment. No direct contact with the user body may be advantageous. A device with no direct contact with a wearer's body may provide significant comfort to the wearer as they may move along with the piece of garment relative to the body as a single unit. In addition, the device with no direct contact to the human body may alleviate the strict requirements on fabric of making as they may present much less or minimal health threats to the human body. For nonlimiting example, no direct contact to the device may help avoid or reduce skin rashes due to friction, allergy to the belt fabric, overheating the skin by the belt fabric, low breathability of the belt fabric, or the like. It may also reduce the cost of fabric in its making. Further, a device not visible from outside may also provide high cosmetic values to the pieces of garment.

[0080] Referring to FIG. 10, in a particular embodiment, an activity bottom includes five elastic bands, four elastic bands optionally aligned in direction of groin oblique muscles, and/or adductor muscles, the other one elastic band optionally wraps around the waist. The five elastic bands may be similar in position and function as the elastic bands in FIGS. 6, 7. In this case, the alignment of elastic bands facilitates band stretching to maximize protection and support for sport hernia and/or groin strain. In some cases, a separate set of base layer compression shorts may add an insert **1015**, **1016** for padding to the sides (hip) and/or to the back (coccyx) for additional protection in activities.

[0081] Referring to FIG. 8, in a particular embodiment, a device **80** may be integrated into a sock to provide compression as well as mechanical support for the foot and the lower leg. The device includes one elastic band **817** that optionally wraps around the arch of the fore foot. The device includes two bands optionally wraps below calf muscles **818**, **819** and/or one band optionally wraps around the Achilles' tendon **820**. The alignment of elastic bands facilitates band stretching to maximize protection and support for foot compression, calf compression, and/or Achilles' tendon rupture. In this case, the vertical Achilles's band **820** optionally stops at the gastrocnemius or calf section (bottom panel). In this case, the vertical Achilles's band optionally continues through the gastrocnemius or calf section (top panel). The elastic bands may include special elastic ribbed patterns that may have similar effect as kinesiotaping of the calf and the forefoot. In the same embodiment, the compression sock includes elastic band over-the-calf or below-the-calf. In this embodiment, the compression sock support for Achilles's tendon, calf muscle, and forefoot stability.

[0082] In some cases, the device includes a first elastic **817** at a foot portion of the sock; and a second and a third elastic band **818**, **819** at a leg portion of the sock, wherein the second and the third elastic bands are not substantially parallel to each other and overlap at least partially with each other with an overlapping area **821**. In some cases, the first elastic band is substantially a closed loop wrapped around a part of a foot of a wearer, wherein the part is a forefoot, an arch, or a combination thereof. In certain cases, at least one

of the second and the third elastic bands is not a closed loop, and they intersect in a region higher than an Achilles' tendon region of the wearer.

[0083] In some cases, the elastic bands/strips are integrated into the sock with a top fabric layer, a bottom fabric layer, or both such that the elastic band does not make direct contact with a human body upon wearing and the elastic bands are not visible from the outside upon wearing. In some cases, the device is configured to provide both compression and mechanical support to muscles, at tendon(s), or both of a wearer. In certain embodiments, the device is configured to prevent shifting of the first, second, and third elastic bands with respect to a lower leg and foot upon wearing.

[0084] In some cases, the elastic bands **817**, **818**, **819** include a width of about 1 mm to about 4 cm in a relaxed state, or a length of about 1 cm to about 50 cm when the device is in a relaxed state. In some cases, the length of the elastic bands/strips that fits around a calf region, a forefoot, an arch, an Achilles' tendon region, or a combination thereof upon wearing. In some cases, a longest dimension of any two of the elastic bands/strips intersect with an acute angle between 10 degrees and 89.9 degrees, wherein the acute angle is adjustable by a wearer.

[0085] In some cases, the device is configured to support a calf muscle, a soleus muscle, a gastrocnemius muscle, a plantaris muscle or a combination thereof. In some cases, the device is configured to support the Achilles' tendon.

[0086] In some cases, the device **80** is configured to provide mechanical support and compressive support to the forefoot and muscles of the lower leg thus they are less prone to injuries during activities. Such injuries may include a muscle strain, tear, rupture or the like. Further, the mechanical support may protect weakened muscles due to existing medical conditions. In some cases, the device **80** is configured to reduce tension on the tendon(s) thus they are less prone to injuries during activities. In some cases, the device is different from padding or cushion that reduces injury only by damping external impact(s).

Shoulder Straps

[0087] In some embodiments, the device disclosed herein includes at least one shoulder strap. In some case, the shoulder strap is connected to the garment with the device integrated therein. In some cases, the shoulder strap is connected directly to the garment and directly or indirectly to the device integrated therein. In some embodiments, the connection is through an interface. In some cases, the connection is concealed beneath a top layer of the garment so that it is invisible when the shoulder strap is properly worn. In some embodiments, the shoulder strap is connected to the inside of the piece of garment. In further embodiments, the shoulder strap is connected in a way that it does not press on the breasts of the wearer. In other cases, the shoulder strap is connected in a personalized manner that it provides optimal support to the individual that is wearing it. In some embodiments, the shoulder straps is used for women with different pregnancy stages or users with back problems including back pain.

Fabrics and Materials

[0088] In some cases, the device comprises polyester, rubber, nylon, spandex, elastane, cotton, plastic, metal, polyester, silk, viscose, elasthan, or a combination thereof.

In some embodiments, the device is stretchable in one, two, or three spatial dimensions. In some embodiments, the device and the piece of garment that the device integrated therewithin includes comparable elastic functions so that the garment stretches in a similar fashion as the device stretches. In some case, the garment includes an elastic property that is within a 5%, 10%, 15%, 20%, 25%, or 30% difference range of the matching elastic property of the device. As a non-limiting example, a device has a Young's modulus of 1 gigapascal (GPa), the garment has a Young's modulus of 0.9 to 1.1 gigapascal (GPa) if the elastic property of the garment is within a 10% difference range of the device. In some embodiments, the piece of garment that the device integrated therewithin includes softer materials or fabrics comparing to the device in order to ensure the comfort of the wearer.

[0089] In some embodiments, the device, or the piece of garment has a Young's modulus in the range of about 0.1 GPa to 30 Gpa. In some embodiments, the materials or fabric forming the device or forming the piece of garment have different elastic properties. In some embodiments, the different material or fabric forms a uniform composite material or fabric in at least a part of the device or the garment. In some embodiments, the different material or fabric are used in different regions of the device or the garment thus providing variable elasticity in different regions of the device or the garment.

Garments

[0090] In some embodiments, a piece of garment is a top, a bottom, a sock, a piece of underwear, a piece of base layer, a camisole, a pair of shorts, a skirt, a pair of pants, a jumpsuit, a belt, a wrapping piece, or a combination thereof. In some embodiments, a piece of garment is configured to enclose a device therewithin through connection via the interface and the complimentary interface. In some embodiments, a piece of garment is a regular or an off-the-shelf piece of clothing. In some embodiments, a piece of garment is any clothing article that can be adapted to include an interface or a complimentary interface to hold at least one device disclosed herein concealed and not visually identifiable when the article and the device are properly worn.

[0091] In some embodiments, a red arrow in the figure represents a stretching or pulling direction of an elastic band or an elastic band.

[0092] Unless otherwise defined, all technical terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. As used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Any reference to "or" herein is intended to encompass "and/or" unless otherwise stated. As used in this specification and the claims, unless otherwise stated, the term "about," and "approximately" refers to variations of less than or equal to $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 4\%$, $\pm 5\%$, $\pm 6\%$, $\pm 7\%$, $\pm 8\%$, $\pm 9\%$, $\pm 10\%$, $\pm 11\%$, $\pm 12\%$, $\pm 14\%$, or $\pm 15\%$, depending on the embodiment. As a non-limiting example, about 100 meters represents a range of 95 meters to 105 meters, 90 meters to 110 meters, or 85 meters to 115 meters depending on the embodiments. The term "substantially" refers to less than or equal to $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 4\%$, $\pm 5\%$, $\pm 6\%$, $\pm 7\%$, $\pm 8\%$, $\pm 9\%$, $\pm 10\%$, $\pm 11\%$, $\pm 12\%$, $\pm 14\%$, or $\pm 15\%$ variation. As a non-

limiting example, substantially parallel represents a range of -1 to 1 degree difference, -5 to 5 degree difference, or -15 degrees to 15 degrees of difference from being parallel, depending on the embodiments.

[0093] All publications, patents, and patent applications mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference.

[0094] While preferred embodiments of the present invention have been shown and described herein, it will be obvious to those skilled in the art that such embodiments are provided by way of example only. Numerous variations, changes, and substitutions will now occur to those skilled in the art without departing from the invention. It should be understood that various alternatives to the embodiments, of the invention described herein may be employed in practicing the invention. It is intended that the following claims define the scope of the invention and that methods and structures within the scope of these claims and their equivalents be covered thereby.

1.-77. (canceled)

78. A device integrated in a piece of garment that provides abdominal support to a user comprising:

- a) at least two elastic bands, wherein the at least two elastic bands are not substantially parallel to each other and overlaps at least partially with each other upon wearing;
 - b) an interface attaching said elastic bands to the piece of garment; and
 - c) at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection adjusts a length said elastic bands,
- wherein said elastic bands provides abdominal support to the user, and

wherein the device is integrated in the piece of garment such that at least a portion of the elastic band does not directly contact a body of the user upon wearing.

79. The device of claim 77, wherein each of said elastic bands is elastic in three dimensions.

80. The device of claim 77, wherein the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment.

81. The device of claim 77, wherein the at least one mechanically reversible connection is close to a peripheral side of the body upon wearing.

82. The device of claim 77, wherein the elastic band comprises a width of about 1 cm to about 40 cm.

83. The device of claim 77, wherein the elastic band comprises a length of about 10 cm to about 200 cm when the device is in a relaxed state.

84. The device of claim 77, wherein the elastic band comprises a length that fits around an abdominal region upon wearing.

85. The device of claim 77, wherein the integration is underneath a top layer of the piece of garment.

86. The device of claim 84, wherein the abdominal region is below breasts and substantially above a waist or a belly button.

87. The device of claim 77, wherein the piece of garment is a top.

88. The device of claim 77, wherein the mechanically adjustable connection comprises a belt eyelet, a belt buckle,

a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a strap, a ring, a clip, a hook take, a loop take, an adhesive tape, or a combination thereof.

89. The device of claim 77, wherein the piece of garment, the interface, or the piece of garment and the interface prevents shifting of the device relative to a human body upon wearing.

90. The device of claim 77, wherein an acute angle between a longest dimension of each elastic band is between 10 degrees and 89 degrees.

91. The device of claim 77 provides postnatal support to the user upon wearing.

92. A device integrated in a piece of garment that provides abdominal support to a user comprising:

- a) at least two elastic bands, wherein the at least two elastic bands are substantially parallel to each other and do not overlap with each other upon wearing;
- b) an interface attaching said elastic bands to the piece of garment; and
- c) at least one mechanically adjustable connection, wherein the at least one mechanical adjustable connection adjusts a length said elastic bands,

wherein said elastic bands provides abdominal support to the user, and

wherein the device is integrated in the piece of garment such that at least a portion of the elastic band does not directly contact a body of the user upon wearing.

93. The device of claim 92, wherein each of said elastic bands is elastic in three dimensions.

94. The device of claim 92, wherein the interface is a mechanically reversible interface configured to allow removal and attachment of the device to the piece of garment.

95. The device of claim 92, wherein the at least one mechanically reversible connection is close to a peripheral side of the body upon wearing.

96. The device of claim 92, wherein the elastic band comprises a width of about 1 cm to about 40 cm.

97. The device of claim 92, wherein the elastic band comprises a length of about 10 cm to about 200 cm when the device is in a relaxed state.

98. The device of claim 92, wherein the elastic band comprises a length that fits around an abdominal region upon wearing.

99. The device of claim 92, wherein the integration is underneath a top layer of the piece of garment.

100. The device of claim 98, wherein the abdominal region is below breasts and substantially above a waist or a belly button.

101. The device of claim 92, wherein the piece of garment is a top.

102. The device of claim 92, wherein the mechanically adjustable connection comprises a belt eyelet, a belt buckle, a Velcro fastener, a zipper, a bottom, a hook, a loop, a tie, a strap, a ring, a clip, a hook take, a loop take, an adhesive tape, or a combination thereof.

103. The device of claim 92, wherein the piece of garment, the interface, or the piece of garment and the interface prevents shifting of the device relative to a human body upon wearing.

104. The device of claim 92, wherein separation between two adjacent bands of said elastic bands are of a different elasticity to said elastic bands.

105. The device of claim 92 provides postnatal support to the user upon wearing.

* * * * *