

COMPRESSION GARMENTS AND METHOD OF MANUFACTURE

Technical Field

The present invention relates to compression garments and to methods of manufacture. In particular, this invention is concerned with compression garments
5 including upper body garments and lower body garments.

Background

Prior art compression garments are generally designed to fit the body snugly, but without consideration as to the extent to which muscles increase in bulk and mass during activity. Such prior art garments can become non-static or counter-gradient
10 in this situation. Once a person wearing a static compression garment increases muscle mass with activity, the garment can become tighter in the vicinity of the muscle, which can increase as much as 3-5% in volume. This alters the effect of the static compression and can create undesirable effects, in being undesirably tight or in providing more compression in the wrong places. In turn, this can impede
15 circulation and reduce the effect of lymphatic drainage.

Prior art compression garments do not take into consideration difference in the degree of shortening which takes place during activity and exposure to increased eccentric load (lengthening) for some muscle groups.

There is also a need to provide compression garments which, at least in preferred
20 embodiments, can take into consideration the effect of excess pressure in particular areas, in order to alleviate or avoid injury problems.

As one example, one of the most common running injuries is illiotibial band friction syndrome (ITBFS), sometimes known as "runner's knee". The illiotibial band is a thickening of the lateral or outer soft tissue that envelops the leg, known
25 as the fascia. The illiotibial band extends from the hip to the outside of the knee. The muscles that insert into the upper portion of the band are the tensor fascia latae

and a portion of the gluteus maximus and gluteus medius muscles. The injury normally presents as pain and inflammation on the outside of the knee.

The illiotibial band may become tight for various reasons and the pain may be experienced down the side of the leg. Friction may be caused in the femoral area
5 where the illiotibial band crosses the outside of the knee joint.

It has been found that excess pressure provided by a compression garment may cause friction of the illiotibial band over the hip and knee joint, resulting in or adding to ITBFS. This type of injury can occur with repetitive hip and knee flexion during jumping and running sports, in particular.

10 It is an aim of the present invention, at least in some embodiments, to improve on the compression garments of the prior art by providing compression garments which can reduce the likelihood of injury from ITBFS and/or which can provide focused support and compression on key areas and muscle groups, including the illiotibial band, the gluteus muscles, the Achilles tendons, the calf muscles (triceps
15 surae) and the scapula.

Disclosure of the Invention

In one aspect, the present invention provides a compression garment for clothing a body part, the compression garment having a first panel of stretchable material joined to a second panel of stretchable material by a seam, wherein the stretchable
20 material of the second panel has a higher stretch and recovery characteristic compared to the stretchable material of the first panel, and wherein, in use, the first panel of stretchable material is adapted to support a larger, more powerful muscle group than the second panel.

The body part may be an arm, a leg, the upper torso, the lower torso, or a
25 combination of these. For example, the compression garment of the invention may

comprise shorts, long tights or tops, either as a single garment or in a combination of garments intended to be worn as a suit.

The compression garment of the invention may be made from two or more different elastomeric materials.

- 5 The material of which the compression garment of the invention is made may be chosen from a wide variety of fabric or different fabrics. Preferably, however, the garment of the invention is made of panels of fabrics of elastane or similar stretch material, often combined with nylon or polyester or similar stretch materials of 40 to 60 or up to 500 denier material. The fabric is preferably of specific stretch and
10 recovery. It is greatly preferred that the stretch along the warp of the fabric is between 120% and 225% and its number for recovery is between 5% and 40%.

According to the first aspect of the invention, the stretchable material of the second panel has a higher stretch and recovery characteristic compared to the stretchable material of the first panel. The characteristic of the second panel maybe achieved
15 in any desirable way. For example, the second panel may be made of material which is of lower denier, or greater elasticity compared to the material of the first panel.

It is preferred that the first panel of the compression garment of the invention can effect a compression value of between 5mm Hg and 25mm Hg. It is envisaged that
20 the compression garment of the invention may be used for therapy and in that case, compression levels may be greater, for example, up to 40mm Hg. In most embodiments of the compression garment of the present invention, compression will be of a lower grade, being less than 25mm Hg, ranging down to 5mm Hg, for active wear and 30mm Hg, ranging down to 8mm Hg, for inactive or non sports
25 usage.

The material of the first and/or second panels preferably has a "wicking" effect, so that in use it draws moisture from the body. Such materials are known.

The panels for the first aspect of the invention may be of any suitable shape.

The first aspect of the invention is based on the concept of providing panels in the compression garment to represent patterns of arrangement of muscle structure.

This concept takes into account that the larger, more powerful muscle groups have
5 the most muscle fibres, but their degree of shortening is small. Examples of these muscle groups are the gluteals (gluteus maximus), the quads (quadriceps, located at the front of the thighs), the hams (hamstrings, located at the back of the thighs), the calves (located at the back of the lower leg), the traps (trapezius, located in the upper back of the torso), the lats (latissimus dorsi, mid side back of the torso) and
10 the rectus abdominis (the front abdominals). In preferred embodiments, the first panel fully covers the muscle belly of such muscle groups. It is believed that in this way vasoconstriction of the muscle belly may be reduced and more effective compression over muscle groups with more blood supply may be effected.

An example of a muscle group having a greater degree of shortening and usually
15 having longer tendons is the achilles tendon. This can be exposed to an increased eccentric load (lengthening) during activity. The second panel of the first aspect of the invention can support this type of muscle group, the panel allowing minimal force to stretch with good recovery.

The seam is preferably a flat stitched seam joining panels of elastomeric material.
20 However, the seam is not limited to this. For example, the seam may be a line or ridge of greater thickness than the surrounding area of the compression garment. Thus the seam may be formed by gluing, stitching or any other means.

Stitching is preferably flat stitching using a four or six needle process.

Particularly in the case of the first panel of the compression garment of the
25 invention, it is preferred that the seam or stitching line follows either the origin or insertion point of the muscle and proceeds along fascial lines or bony prominences where there is low blood supply. In an embodiment providing an upper body

garment, it is preferred that the seam follows the fibre direction of the external oblique muscles (outer side abdominals). This can allow the panel of the compression garment to assist with transverse plane, or twisting, movements of trunk function during throwing and running movements.

- 5 When a suitable embodiment of upper body garment of the invention is worn together with a suitable embodiment of lower body garment according to the invention, a concurrent functional mechanism may be created to involve gradient compression during dynamic movements.

In a second aspect, the invention provides a compression garment for clothing a
10 lower body part of a wearer, the compression garment including a first panel of stretchable material joined to a second panel of stretchable material by a first seam, the second panel being joined to a third panel or the first panel by a second seam, wherein the second panel is adapted in use to be located along a substantial part of the illiotibial band of the wearer.

- 15 In one embodiment, the second panel is adapted in use to extend substantially from the tensor fasciae latae of the wearer along the illiotibial band towards the knee.

It is particularly preferred that the first and second aspects of the invention are combined, and that the second panel is joined to a fourth panel of greater elasticity, the fourth panel designed in use to be located over the knee. Particularly if the
20 second panel is of greater elasticity than the first and second panels and the fourth panel is of even greater elasticity, the lower body garment of the second aspect of the invention can be designed to reduce excessive pressure over the illiotibial band and the tensor fasciae latae, at the same time allowing the desired degree of knee flexion.

- 25 In a third aspect, the invention provides a compression garment for clothing a body part being a lower leg of a wearer, the compression garment having a first panel of

stretchable material joined to a second panel of stretchable material by a seam adapted in use to at least partially divide the triceps surae of the wearer.

Preferably, in the third aspect of the invention the seam splits the lateral and medial gastrocnemius attaching the superior portion of an achilles panel at the musculo-
5 tendonous junction.

The third aspect of the invention is based on the concept that the calf muscles of the lower leg are required to contract forcefully in running and jumping movements. If the calf muscles become fatigued or are functionally weak during excessive contractions over a period of time, eccentric contractions, such as
10 landing of one leg to the ground during running, can cause these muscles to tear. The third aspect of the invention can provide, in effect, a dual panel system which can permit individual, specific support and compression of gastrocnemius bellies. This may help reduce localised fatigue of the triceps surae region and help limit calf muscle injuries.

15 In one embodiment of the third aspect of the invention, the compression garment takes a form of an elongated sock or stocking.

In an especially preferred embodiment, the first, second and third aspects of the invention are combined to result in a lower body compression garment, such as long or short tights, with the features of all three aspects. In this especially
20 preferred embodiment, the compression garment includes an achilles panel which represents a second panel according to the first aspect of the invention.

It will be appreciated by one skilled in the art that the compression garments of the invention, in appropriate aspects, can utilise a combination of compressive and high stretch/recovery fabrics in the postero-lateral panels of the waist and thigh.
25 This can help to create a complementary functional mechanism of the oblique muscles, the gluteus maximus, the illiotibial band and the tensor fascial latae.

In preferred embodiments, in relation to the compression garment being a lower body garment, it is preferred that the waist band is made from a panel of stretchable material having chosen stretch and recovery characteristics designed so that the waist band does not need to include an elastic insert in the rear of the garment. In this embodiment, it is optional to have an elastic insert in the front of the garment. It will be appreciated that this is different from prior art arrangements, in which an elastic insert encircles the waist or, where an elastic insert is included in only part of the waist band, the elastic insert is used at the back of the garment rather than at the front. Construction of the type described in relation to the lower body garment of the invention can provide vertical stability.

The embodiment of waistband described above represents a fourth aspect of the invention, but preferably is used in combination with any or all of the first, second and third aspects of the inventions.

In a fifth aspect, the invention provides a compression garment for clothing an upper body part of a wearer, the compression garment having a first panel of stretchable material joined to a second panel of stretchable material by a seam, wherein the seam is adapted in use to lie along a fibre direction of the external oblique muscles of the wearer.

In one preferred embodiment, the upper body compression garment of the fifth aspect of the invention has the seam joining the first and second panels placed so that, at the front of the garment, the seam is located above the wearer's diaphragm area. It is further preferred that, at the rear of the garment, the seam is shaped in an upward curve to provide compression to the scapular muscles while allowing more flexibility to the lower part of the wearer's torso.

It is particularly preferred that a third panel of higher elasticity is inserted on the rear of the upper body garment in the region of the wearer's spine to permit stretching and twisting.

Optionally, the compression garment of the invention in any of its aspects may include one or more mesh inserts, for the purpose in aiding ventilation or to assist in dissipating body heat. In the case of a lower body garment, for example, a mesh insert may be provided located below the waist band at the upper back. It is a
5 further option that there may be a second mesh insert in the crotch area.

For an upper body garment, for example, a mesh insert may be provided in the underarm region or at the neckline or any other desired location.

The invention also provides a method of manufacture of the compression garment of any of the aspects of the invention, the method including these steps of
10 providing a first panel of stretchable material and a second panel of stretchable material and joining the first panel to the second panel by a seam.

It will be apparent to one skilled in the art that many of the preferred embodiments described above in relation to the first aspect of the invention are also applicable to the other aspects of the invention.

15 **Brief Description of the Drawings**

To assist with understanding the present invention, reference will now be made to certain non-limiting embodiments in the accompanying drawings, in which:

Figure 1 shows a front view of a first embodiment of a lower body compression garment in accordance with the first, second, third and fourth
20 aspects of the invention;

Figure 2 shows a side view of the embodiment of Figure 1;

Figure 3 shows a rear view of the embodiment in Figures 1 and 2;

Figure 4 shows a front view of a first embodiment of an upper body compression garment, illustrating the first and fifth aspects of the invention;

Figure 5 is a side view of the embodiment in Figure 4; and

Figure 6 is a rear view of the embodiment in Figures 4 and 5.

Detailed Description of the Invention

Referring first to Figures 1 to 3, compression garment 10 is shown as a lower body
 5 garment in the form of long tights, for clothing a body part being the lower torso,
 from approximately the wearer's waistline to the wearer's ankles.

Long tights 10 have first panels of stretchable material 12A and 12B and a second
 panel of stretchable material 14. First panel 12A is joined to second panel 14 by
 second seam 18 First panel 12B is joined to second panel 14 by first seam 16.

10 Effectively, first panel 12 is divided into two parts, 12A and 12B, panel 12A
 covering the front of the wearer's thigh as shown in Figure 1 and panel 12B
 covering the back of the wearer's thigh as shown in Figure 3, with a seam (not
 shown) joining the panels 12A and 12B running along the inside thigh of the
 wearer.)

15 First panels 12A and 12B require more force to stretch and therefore are less
 elastic than second panel 14.

First panel 12B is adapted to support the gluteus maximus of the wearer, located at
 20, and the hamstrings, located at 24. First panel 12A is adapted to support the
 quadriceps, located at 22

20 It will be noted from Figures 1 and 2 that second seam 18 is located so that it
 crosses the upper leg of the wearer above the knee region 26 and so does not
 impede knee flexion.

It will also be noted from Figure 2 that second panel 14 is located along a
 substantial part of the illiotibial band of the wearer, terminating above knee region

25 26 at third seam 28.

In this embodiment, knee region 26 is covered by a further panel 30. This may be a material of similar elasticity to second panel 14, but preferably is made from a material of even greater elasticity than second panel 14, so as not impede knee flexion.

- 5 At the lower leg of compression garment 10, seam 16 is continued to wrap around to the rear of the lower leg so that it at least partially divides the triceps surae of the lower leg at 32. Seam 34 similarly travels from the region of the wearer's inner thigh to meet seam 16 at 32. It will be noted that seams 16 and 34 where they merge at 32 effectively divide the calf muscles 36 and 38 of the wearer's lower leg.
- 10 In this embodiment, panel 40 is bordered by seam 34 and seam 42 (refer Figure 1) which lies along the bony prominence of the tibia.

Panel 44 is bordered by seam 42, the extension of seam 16 and lower seam 46 to knee panel 30. It is preferred that panels 40 and 44 are made of the same material as first panels 12A and 12B.

- 15 As shown in Figure 3, a further panel 48 supports the wearer's achilles tendons, being formed between extensions of seams 16 and 34. Preferably, panel 48 is made from a material of greater elasticity, such as that of second panel 14 or that of knee panel 30.

- As shown in Figure 1, long tights 10 have crotch panel 50 joined by seams 52 and
20 54 two first panels 12A. Crotch panel 50 may be of the same elasticity as first panels 12A or of a different elasticity.

Crotch panel 50 is joined to an upper panel 56 by seam 58. Once again, panel 56 may be of the same elasticity or of a different elasticity compared to the surrounding panels.

As can be seen from Figure 3, seam 60 joins the panels 12B and travels between the gluteus maximus locations 20. Panel 62 lies above seam 60 and below waistband 64. If desired, panel 62 may consist of or may include a mesh panel to assist in ventilation. A further mesh panel may be included in crotch panel 50 or
5 elsewhere located near the wearer's crotch.

As may be seen from each of the Figures 1 to 3, waistband 64 is shaped by seam 66 so that compression garment 10 sits flatly at the wearer's waist.

In this embodiment, waistband 64 has no separate elastic insert, except within the front of waistband 64 between seams 68 and 70.

10 Compression garment 10 is manufactured by providing each of the respective panels and joining them by each of the respective seams to provide the desired shape for the intended wearer.

Although Figures 1 to 3 show compression garment 10 in a form of long tights, it will be appreciated that the first and second aspects of the invention may be
15 embodied in a short tight version which is truncated above knee region 26.

Turning now to Figures 4 to 6, compression garment 80 is shown in the form of an upper body garment which in this embodiment has long sleeves 82 and 84. It will be appreciated, however, that it is within the scope of the invention that long sleeves 82 and 84 are not included or are present in the form of shorter sleeves.

20 Compression garment 80 has first panel 86 joined to second panel 88 by seam 90. Seam 90 is intended to follow the fibre direction of the external oblique muscles of the wearer, located at 92 in order to assist with twisting movements of the wearer during activity. First panel 86 is of a material of lower elasticity than second panel 88. This provides compression to the upper part of the wearer's torso while
25 allowing greater elasticity over the diaphragm area 94.

As can be seen from Figure 5, seam 90 is intended to travel along the lower extremity of the latissimus dorsi at 96.

As can be seen from Figure 6, seam 90 rises up again at the rear of upper body garment 80 to support the scapular muscles.

- 5 In the illustrated embodiment, and as can be seen from Figure 6, upper body garment 80 has panels 98 and 100 separated by further panel 102. Panels 98 and 100 are made of the same, relatively low elasticity, material as panel 86. However, panel 102 is made from a higher elasticity material, either the same as that of panel 88 or of a different elasticity, the purpose of panel 102 being to permit proper
10 movement of wearer's back during activity, whilst still providing compression through panels 98 and 100.

In the embodiment shown, further seams 104 are provided to help anchor arm muscles.

Side seams 106 are provided to assist in shaping upper body garment 80.

- 15 Optionally, side seams 106 may permit side panels 108 and 110 to be of different elasticity compared to other panels, such as panel 86 and panels 98 and 100.

As with long tights 10, upper body garment 80 may have mesh inserts to assist in ventilation. These may be used, for example, in neck panel 112 or in underarm panels 114.

- 20 All seams referred to in the above embodiments are made using 4-needle flatlock stitching and may serve to anchor muscle groups and assist in compression.

It will be appreciated by those skilled in the art that many modifications and variation may be made to the embodiments described herein without departing from the spirit or scope of the invention.

Industrial Applicability

This invention is industrially applicable in that the compression garment is capable of taking into consideration the effect of excess pressure in particular areas in the body of the wearer thereby alleviating or avoiding injury problems.

Claims

1. A compression garment for clothing a lower body part of a wearer, the compression garment having a first panel of stretchable material joined to a second panel of stretchable material by a first seam and a second seam, wherein the stretchable material of the second panel has a higher stretch and recovery characteristic compared to the stretchable material of the first panel, and wherein, in use, the first panel of stretchable material is adapted to support a larger, more powerful muscle group than the second panel; wherein the second panel is joined to a third panel by a third seam, the second panel being adapted in use to be located along a substantial part of the illiotibial band of the wearer;, the third panel designed in use to be located over the knee.
2. The compression garment of claim 1, wherein, the third panel is of greater elasticity than the second panel so as to allow knee flexion.
3. The compression garment of any one of the preceding claims, which includes a waist band made from a panel of stretchable material having a chosen stretch and recovery characteristics designed so that the waist band does not need to include an elastic insert in the rear of the garment.
4. The compression garment of claim 3, further including an elastic insert in front of the garment.
5. The compression garment of claim 3 or 4, further including one or more mesh inserts, for the purpose in aiding ventilation or to assist in dissipating body heat.
6. The compression garment of claim 5, wherein the mesh insert is located below the waist band at the upper back.
7. The compression garment of claim 5 or 6, wherein there is a second mesh insert in the crotch area.