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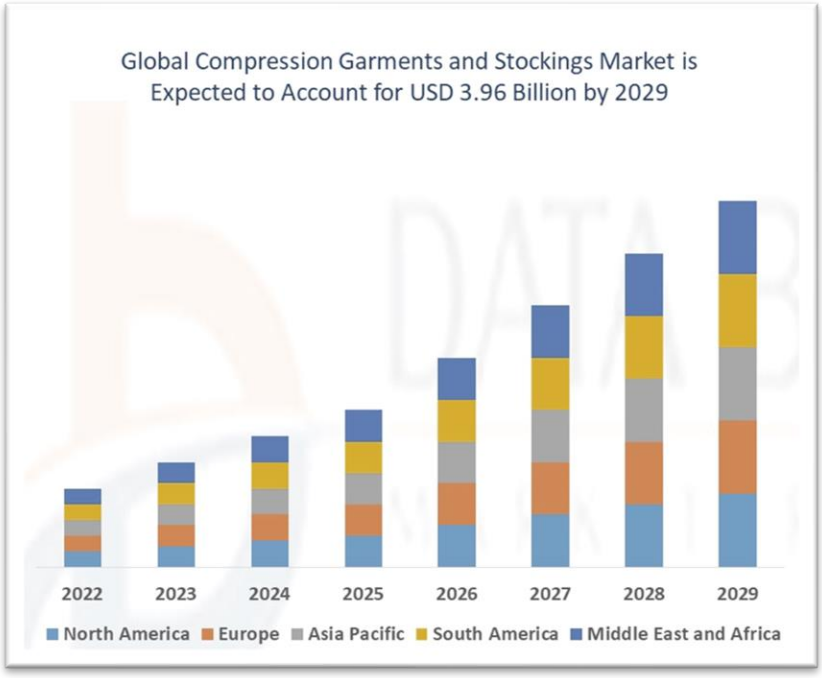
DIVERSIFIED MEDICAL AND SPORTS APPLICATIONS OF COMPRESSION GARMENTS

DR.S.KAVITHA, ASSISTANT PROFESSOR III,
MS.KALAIARASI.S, MS.GNANAVASANTHI.T, M.TECH SCHOLARS,
DEPARTMENT OF FASHION TECHNOLOGY,
KUMARAGURU COLLEGE OF TECHNOLOGY,
COIMBATORE 641049

The compression therapy market is growing fast. Compression garments have been used to apply a defined pressure to the body for various reasons in the case of medical, sports and body shaping purposes. Compression garments are used by athletes globally and also by physicians to treat any kind of limb or muscular injury. Compression clothing is made of a blend of spandex and nylon or polyester and engineered to be stretchable while maintaining a specific structure It is used in different forms like compression stockings, socks, shorts, gears, and bandages. The main function of sports compressive garments is to maintain muscle functions, reduce sports injuries and improve athletic performance. The benefits of medical-grade compression garments are improved blood circulation, increased oxygenation of muscles, and reduction of muscle inflammation and risk of injury. The compression garments market is extremely prosperous because of the constant modernization drive happening in the sports, fitness and healthcare sector. This article critically highlights the design aspects of compression garments for suitability in sports and medical applications.

INTRODUCTION

A relatively new treatment for sore muscles and aching joints that squeezes problem areas is in the midst of a major expansion. Compression therapy, which utilizes garments like shirts, leggings, and stockings, is projected to continue to rise in popularity through 2030. Compression garments have gained importance in sports and medical applications. Proponents of compression therapy and garments say the popularity of these techniques is surging because of increases in the amount of people with diabetes as well as an aging population and more frequent sports injuries. Compression for sportswear is a growing market and in recent times, greater awareness among athletes has led to an increased usage in a wide range of sports. Major international events such as Olympics and athletic championships, also have triggered new technological developments in compression garments.



PRINCIPLE OF COMPRESSION

Fabricating a compression garment with a required pressure is important. Pressure exerted by a garment is largely determined by the fabric tension per unit length and its anisotropic behavior. It is also influenced by the number of fabric layers used for its construction as well as by fabric grain direction that must be aligned with the stretching direction. Compression therapy is based on the Laplace equation which states that pressure

is directly proportional to the amount of tension and number of layers applied and inversely proportional to the limb circumference and width of the material applied.A unit pressure applied on the parts of the covered body is a crucial factor of compression garments that supports the process of external therapy.

LAPLACE EQUATION

$P = (TN \times 4630) / CW$

- P = pressure in mmHg
- T = bandage tension (in kgf)
- N = number of layers applied
- C = circumference of the limb (in cm)
- W = bandage width(in cm)

The pressure gradient between the ankle and calf makes the compression effective in managing the circulation problem.

GRADUATED COMPRESSION

Graduated compression stockings exert the greatest degree of compression at the ankle, and the level of compression gradually decreases up the garment. The pressure gradient ensures that blood flows upward toward the heart instead of refluxing downward to the foot or laterally into the superficial veins. The application of adequate graduated compression reduces the diameter of major veins, which increases the velocity and volume of blood flow.

DIFFERENT TYPES OF COMPRSSION GARMENTS

- Compression stockings
- Compression Bandages
- Compression shirts(sleeveless ,short sleeve, long sleeve)
- Compression shorts and tights
- Compression leg sleeves
- Compression arm sleeves

FABRIC FOR COMPRESSION GARMENTS

Compression garments are usually made of fine knitted fabric that contains 80-75% polyester or nylon and 20-25 % elastomeric filaments, which stretch and recover back to their original shape during physical movements of the body. Their crucial properties are elasticity and recovery, since they are able to exert continuous pressure on the human body.

In a typical flat knit, stretch fabrics can be produced using inlay and body yarn (elastomeric yarn) that imparts stretch-ability to the fabric. The stretch and recovery characteristics of two types of knitted fabrics have been studied at various extension levels, and found that spandex plated cotton fabric is more excellent in dynamic elastic recovery than spandex core cotton spun fabric. A recent US patent (Young, 2009) on the manufacture of compression garment for sportswear highlighted the number of panels required to isolate and support specific muscle groups and aid in blood circulation or assist in reducing soft tissue injury. It also added that panel shapes and seams correspond to various muscle groups for a whole body compression garment.

MEDICAL APPLICATIONS

The majority of medical compression garments are individually designed and produced for a specific part of the body, like stockings, gloves, sleeves, face masks and body suits. They have been worn for a specific period, based on the requirement of medical treatment.

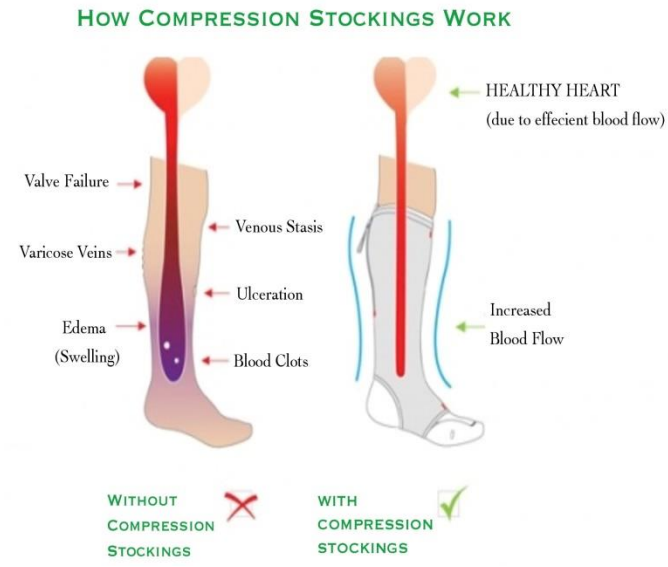
VARICOSE VEINS

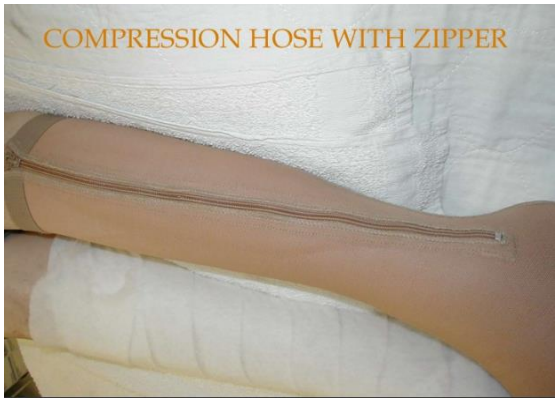
Compression stockings (or socks) are a special kind of elastic hosiery that supports healthy blood circulation and helps prevent a variety of health conditions, including:

- chronic venous insufficiency
- spider veins

- varicose veins

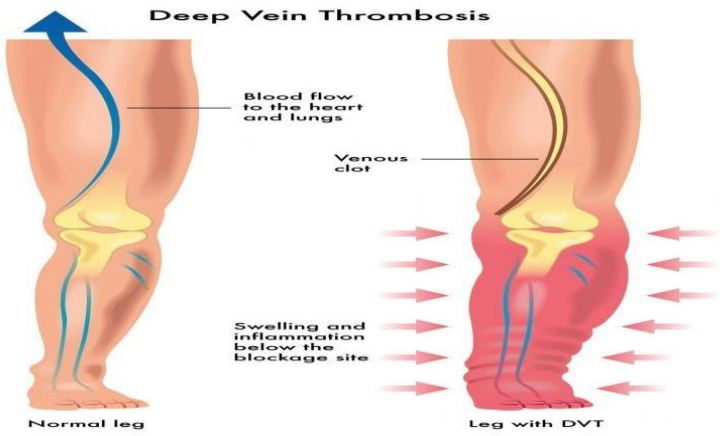
The pressure that these stockings put on the ankles and legs compresses the surface arteries and veins, helping the vein valves to function properly and blood to flow back to heart without obstructions.





DEEP VEIN THROMBOSIS

Deep Vein Thrombosis (**DVT**), is the formation of a blood clot in a deep vein, most commonly the legs.[1][a] Symptoms may include pain, swelling, redness, or warmth of the affected area.



Lymphedema is a chronic condition in which excess fluid (lymph) collects in tissues causing edema (swelling). Lymphedema occurs when your lymph vessels are unable to drain the lymph fluid, usually from an arm or leg. Lymphedema can be either primary meaning it can be present at birth or may develop later in life.

.Compression garments are used widely in the management of lymphedema. Garments are available in both custom-made and prefabricated varieties. Also, garments may be obtained in a gradient format in which distal compression is greater than proximal compression. In addition, sleeves have been introduced recently that permit manual, inflatable pressures against the limb.

SCAR MANAGEMENT

Pressure therapy for scar management, also known as compression therapy, is an important component of a burn patient's rehabilitation program. Elastic bandages or compression garments are used to provide pressure over healing burns and grafts when they are durable enough to tolerate the shearing that occurs from the fabric against the skin. This compression minimizes the development of scars by interfering with the production of collagen and helping to realign the collagen fibers. Benefits associated with compression include its ability to:

- Protect fragile skin
- Promote better circulation of damaged tissues
- Decrease extremity pain through vascular support
- Decrease itching
- Reduce thick, hard scars
- Increase skin length by putting pressure on contracture bands

SPORTS APPLICATION

Compression garments have become a popular item for athletes and recreational gym users, whether that is for their comfort, aesthetical appeal, or for their psycho-physiological function appears to be irrelevant. What is important, primarily for athletes, is their ability to promote recovery and thus improve subsequent performance. The current body of research identifies that compression garments may improve joint awareness, local blood flow, waste product removal, improve running economy, reduce swelling, reduce muscle oscillations, and decrease post-exercise muscle soreness whilst appearing to have no negative impact on performance.

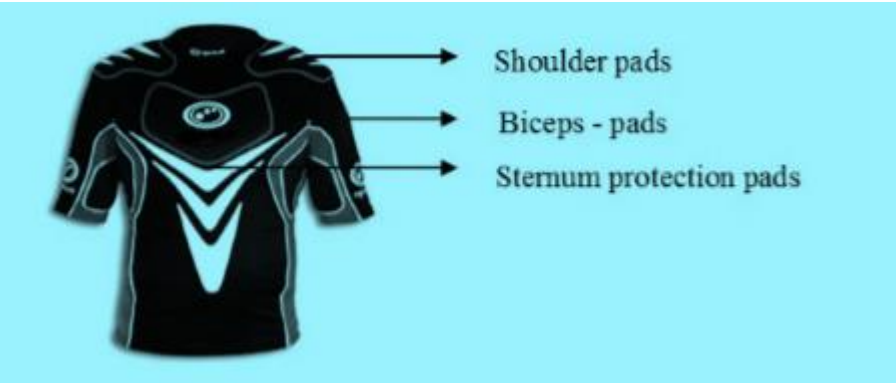
Compression garments are designed to help improve performance and reduce recovery time. They improve blood circulation to provide a more effective blood flow to filter toxins from muscles during exercise (lactic acid) and provide better oxygenation to the muscles. They also have a muscle stabilizing effect; to bring better muscle alignment and reduce micro-tears. The user can therefore hope to perform better; have less leg heaviness, while reducing the risk of cramps and feel less muscle aches after training. Indeed, one of the benefits of compression garments for athletes is a faster recovery; reducing, in addition, muscle pain, which usually occurs after an intense physical exercise. Compression garments have become a staple for athletes' in these sports, as support is required for muscles continuously, providing aid in reducing muscle fatigue

A wide range of compression wear is available for professional cycling. A range of garments are available for professional cycling; including sleeve jersey, sleeveless jersey, long sleeve jersey, jacket, vest, long and short sleeve skin suits, bib shorts, tights and knickers.

A cyclist in action wearing a compression garment

Typical base layer garments for skiing include full sleeve tops, tights and one-piece garments that cover torso, arms and legs. A ski base layer compression garment keeps the wearer warm in cold conditions as well as supports muscle movements.

In rugby, 57% of most sport injuries occur during matches rather than in training and particularly when a player tackles or is being tackled (South Wales Osteopathic Society, 2009). Hence, most compression garment will have protective pads in tops and shorts. The range of compression garments for rugby include sleeve tops, full sleeve tops, shorts, tights, calf sleeve, and socks.



Typical tops for rugby with impact protection pads

Compression tights may be useful for people with certain existing injuries, by providing support to minimize undesired movement of underlying tissues – much like support straps and bandaging does.

A scientific study carried out on more than 1200 sportsmen and presented to the last International Olympic Committee (Monaco 2014)* has shown a significant reduction in risk of injuries (29%) when a sportsman always and rigorously use compression during his training and competitions.

The markets are now leading with compression garments with additional features like antimicrobial protection, antistatic properties, improved breathability and excellent moisture management. Superior quality compression garments guarantee fabric durability and are made of stain release technology. These garments are created to regulate the athlete's temperature and also offer protection against ultraviolet (UV) rays. Compression garment manufacturers are now working on developing a new range of fitness products with an eye on high-stamina sports like parachuting, aerobics, and windsurfing.

CONCLUSION

New innovative compression garments for sportswear will continue to be developed due to interest from athletes, enthusiasm from amateurs, and demand for casual leisurewear. Compression garments appear not only to support the performance but also more importantly portray a professional approach. Compression garments and stockings are easy-to-use, safe, and provide effective treatment in a short period, which will continue fuelling their sales in the long run.

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