STOKO K1
TARGETED COMPRESSION

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The purpose of this document is to review the compression level of the K1 and present a foundation of scientific knowledge surrounding the benefits of compression.

Introduction

Athletes commonly use compression garments (CGs) for their positive effects on performance and recovery. These effects are credited to improved proprioception and increased blood flow, among others (1–7). The Stoko K1 was designed to include varying zones of targeted compression to unlock these benefits for our athletes.

Garment compression is a measurement of pressure applied to the body in millimeters of mercury (mmHg). The compression level can vary dramatically depending on the use case. To bring clarity to different levels of compression, classification systems have been created. For this document, a common North American rating standard will be used to classify the different grades of compression (8,9). These classes are as follows:

Compression Class	mmHg
1 Mild	8-15
1 Moderate	15-20
1 Firm	20-30
2 Extra firm	30-40
3 Prescription Level	40-50

The purpose of this document is to review the compression level of the K1 and present a foundation of scientific knowledge surrounding the benefits of compression.

The K1

The K1 is a knee brace that uses the Embrace System™, a network of cables under tension, to support the knee. It comes in the form factor of a compression tight in addition to its bracing capabilities. Stoko uses targeted compression to vary the compression level across different regions as shown in Figure 1. When tensioned, the Embrace System™ can supply increased levels of compression to localized areas of the leg. For the following investigation, this effect has been excluded and the reported compressivity is purely that of the K1s fabric.

The compression gradient in the K1 was measured according to the RAL-GZ 387/1 protocol by an independent testing facility - Hohenstein (Bönnigheim, Germany) (10). Compression through the calf and thigh were measured at Class I Mild, while the Knee was measured at Class I Moderate*. Figure 1 summarizes the results.

** Different countries and regions use different compression ranges (in mmHg) to classify the compression level. The classification in this paper represents a North American rating system.*

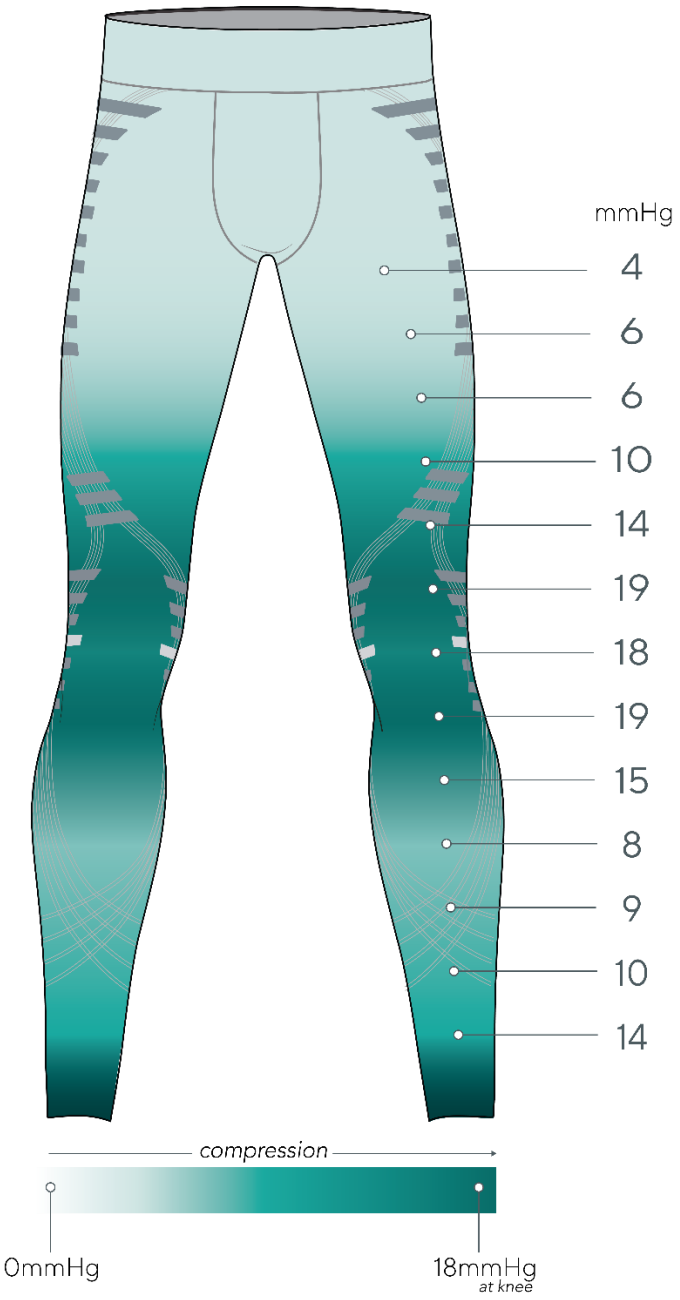

Figure 1. Targeted Compression Distribution on the Stoko K1

Improved Performance

Athletes continue to seek performance advantages through many varied options open to them. Compressive garments provide well-documented, positive effects in the areas of warm-ups, proprioception, fatigue, and blood flow.

Effective Warmups

An effective warm-up is crucial for optimal exercise. It reduces the time to achieve peak performance as well as injury potential during intense, dynamic activities (11). CGs increase skin and muscle temperature beyond traditional athletic wear (12). Proper warm-ups have a strong correlation with injury prevention (13). This temperature increase allows athletes to achieve an effective warm-up quickly, reducing overall exercise time as well as reducing injury chance.

Improved Proprioception

Proprioception is our subconscious perception of our body's movement and location in space. It plays a major role in coordination, stability, and our ability to react in athletic situations, or circumstances that could lead to injury. Compression garments improve proprioceptive acuity, increasing the sensitivity and precision of movement (4). This allows dynamic movements to be quicker, more precise, and more efficient.

A series of articles written by Hanzlíková et al (2016, 2019) investigated the effects of proprioceptive knee bracing on joint control during dynamic movements. They first show an increase in control during dynamic movements in healthy subjects (14), and second show a similar increase in patients post ACL reconstruction (15). The increase in control is related to perceived improvements in proprioception and reduced muscle oscillation.

Muscle oscillation occurs naturally during dynamic movements, causing nerves involved in proprioception to fire erratically. Uncompressed muscle exhibits an increase in oscillation amplitude and duration. By compressing the muscle, this oscillation is reduced (12), removing the excess signal noise associated with natural muscle oscillation. The brain would then receive a more unified signal, in theory making it easier to process this information (4). It is theorized that it is due to the normalization of mechanoreceptor signals within the limb and the associated reduction in muscle oscillation that compression provides (4).

Reduced Fatigue

Excessive oscillation results in greater fatigue and increases the likelihood of acute muscle injury (16). Compression, in effect, holds the muscle in place, reducing oscillatory movement significantly. Doan et al demonstrated that compressing musculature reduced oscillation magnitudes between 40%-50% during a jump squat test (12). Kraemer *et al* showed a significant reduction in stabilization time in a similar jump squat test (16). By compressing the muscle and reducing oscillation, fatigue build-up and acute muscle injury potential are reduced (16).

Increased Blood flow

Proper blood flow facilitates more effective transport of nutrients and waste, which increases athletic performance, and facilitates a more effective recovery. Unfortunately, any moderate amount of exercise is accompanied by muscle swelling, which restricts blood flow. Compression of active muscle decreases post-exercise swelling (7), counteracting the associated decrease in blood flow. Extensive research has shown that compression results in an increase in stroke volume both at rest and post-exercise, a decrease in heart rate post-exercise, and a decrease in diastolic blood pressure post-exercise (6).

Recovery

Exercise

Muscle damage is an unavoidable side effect of exercise and part of the natural process of muscle growth. CGs have been shown to increase exercise recovery rates through several metrics. Blood concentrations of muscle damage by-products (creatine kinase and blood lactate) show a significant post-exercise decrease when CGs are worn (7,17). Creatine kinase concentration shows an initial spike above the norm, but then drops off dramatically 2-3 days earlier than the control (7). This reduction in muscle damage by-products is likely caused by increased blood flow associated with CGs. Multiple studies show a reduction in delayed onset muscle soreness, joint stiffness associated with intense

exercise, faster recovery, and an increase in follow-up exercise performance (7,18–20). Most of these effects can be tied to increased blood flow and a reduction in muscle fatigue from muscle oscillation. Reducing short-term pain and motion loss means an athlete can recover faster and return for follow-up exercise sooner, resulting in more training and better performance.

Injury

Most athletes experience some form of accident, be it a minor cramping episode, or major injury such as ligament tears. In some cases, compression can have a notable positive effect. An ACL injury is accompanied by a decrease in proprioception that persists beyond reconstructive surgery. A decrease in stability, perceived confidence (2), and muscle strength (21) in the affected joint is typical. As previously established, compression increases proprioceptive ability which counteracts the effects of the injury. It is further theorized that this increase in proprioception increases muscle awareness and therefore joint stability and muscle coordination. This is supported through testing which shows a significant increase in stability during dynamic movement, as well as an increase in perceived confidence in the affected joint when compression is applied, leading to more effective rehabilitation (2,21).

Conclusion

Achieving peak performance is a difficult multifaceted task. Compressive clothing can provide athletes with a step-up through improving proprioception and blood flow. The K1's targeted compression was built into the garment to provide many of these well-researched benefits to help athletes unlock their peak potential.

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