Proper Implementation of Compression Garments

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Working in the complimentary fields of medicine and exercise physiology can provide insight in to new ideas and products. It can also aid in teasing out how the theories behind various practices are developed. An example of this is the use of compression garments to aid recovery and increase performance. While increased recovery or enhanced performance, regardless of the mechanism of action, is beneficial, a review of literature reveals little data supporting the benefit of compression garments in athletes.

Compression garments are not new devices. Their use in medicine has been wide spread for a number of years. Forms vary from tight stockings covering from the calf and thigh to pneumatic devices that contract and release at programmed intervals. The most common use is to prevent clots from forming in individuals with circulation issues. Essentially, a pooling of blood can occur in the limbs called venostasis. This pooling is a prime environment for small clots to form as the blood sits in place. When an event occurs that allows the pooled blood to be pushed back to the heart, these clots can then cause strokes, pulmonary embolisms, and heart attacks. This is the same mechanism that prompted walking and moving around in an airplane on long flights. By compressing the limbs with appropriate garments, venous return can then be improved and therefore significantly reduce stroke and heart attack risk non-invasively.

A key factor in this, however, is the role of an individual's mobility. The mechanism by which blood returns to the heart is called the skeletal muscle pump. As a muscle contracts, the veins are compressed causing blood to be pushed under pressure. It then moves towards the heart due to a series of valves in the vasculature. These essentially make the veins one-way as they shut if blood tries to go the wrong way. The valves are similar to airport security-- once you pass it, you can't go backwards, but instead, have to circulate all the way back around.

Compression garments are not a standard issue item when a patient enters a hospital or other health care facility. Rather, they are used in patients with severely impaired mobility. This can include degenerative diseases, stroke, or simply being too weak to move. Essentially, these individuals no longer have an effective skeletal muscle pump. But, if or when mobility returns, the use of the garments is discontinued. This can include a patient simply being able to walk to the bathroom or self-propel using their legs in a wheelchair. The key factor in this is the small amount of mobility required to negate the need for the garments.

Contrast this with the athlete population. The skeletal muscle pump is used throughout exercise. Then, after a workout, these individuals are able to move around normally, typically without any form of venous insufficiency. With these facts, it appears that the method of action used in ill patients would not be applicable in healthy athletes. However, since strenuous exercise may alter some bodily functions as well as the fact that a secondary mechanism of action may exist, it is still important to assess the data to see if benefits are seen.

Very little evidence can be found in recent literature supporting the use of compression stockings during or after exercise. Studies vary from comparing explosive type movements to submaximal endurance activity. For instance, Dufield and Portlus (2007) had cricket players wear compression garments with sprinting and throwing exercise. No benefit was seen in a second round of testing in sprint, throwing and submaximal exercise performance. This has been confirmed when looking at training with repeated bouts of high intensity activity (Duffield et al. 2008; Pruscino, Halson, & Hargreaves 2013). Measuring common physiological variables, researchers have shown a lack of benefit when comparing VO_2max and blood lactate levels when the garments are worn during exercise. Further, there was no difference in performance in well trained athletes when comparing compression stockings, socks, and whole body garments (Sperlich et al. 2010).

Commonly, as coaches we emphasize the principal of specificity in training. This is the idea that training has to be tailored to the sport and specific to its demands. Scientific literature also falls under this principal when evaluating variables. And as such, research specific to endurance performance has been done to evaluate the effectiveness of compression garments. Ali, Cane, and Snow (2010) found that 10K run performance was not affected when compression garments were worn during the event. Additionally, when worn during competition, no benefit was seen in improved performance or decreased fatigue when completing a half ironman distance triathlon (Del Coso et al, 2014). More specific to cycling, no benefit was seen during time trial performance. Additionally, a positive effect under the theory of improved circulation was not seen in regards to lactate threshold, VO2, heart rate, and gas exchange at the working muscle (Scanlan, Dascombe, Reaburn, & Osborne 2008). And while not performed with endurance sports, the work of Montgomery et al. (2008) evaluated the efficacy of the garments under three day tournament conditions with basketball players. This would be similar to a stage race or a weekend with racing on consecutive days. Again, a benefit with compression garments as a recovery modality was not seen. This is especially true when compared to cold water therapy, which, in itself has its own strengths and weaknesses.

While most of the data indicate that the use of compression garments does not provide an advantage, there are a handful that do show possible benefits. It is important, however, to tease out the possible causes and evaluate the efficacy of the items. For instance, Bringard, Perrey and Reaburn (2006) found that running economy may be improved with the use of compression stocking during exercise. However, this study was done with athletes running at 80% of VO2max with no performance measurements. Additionally, the cause for the change in economy could not be attributed to a specific mechanism.

Another example are the decreased levels of creatine kinase that have been reported with the use of compression garments (Dufield and Portas 2007). What exactly does this mean? Basically, creatine kinase, and the sometimes measured myoglobin, are enzymes only found inside cells. When a muscle becomes damaged, some of the contents are released in to the blood. As a result, levels of enzymes normally found in the cells increases in the circulation. Creatine kinase measurements are often used to help diagnose a heart attack. When the heart muscle is damaged, the levels of the enzyme specific to cardiac muscle spike. The same principal applies to muscle damaged with exercise. In the cited study, the cricket players wore the garments during and after exercise. As a result, it cannot be distinguished if the decreased creatine kinase levels is a result of improved blood flow, and therefore clearance of the enzyme, or a decrease in muscle damage through some other mechanism, preventing a possible increase from even occurring. Additionally, the difference in enzyme levels is not consistently seen when compression garments are implemented (Jakeman, Byrne, & Eston 2010; Duffield et al, 2008; Duffield, Cannon, & King, 2010). Myoglobin and creatine kinase were also shown to not be affected by the use of the garments during half ironman distance triahlon, further indicating that the garments may not prevent muscle damage (Del Coso et al, 2014). This, coupled with the fact that no differences in lactic acid and muscle pH at various time periods after exercise (Duffield et al., 2008) indicate that the use of compression stockings does not alter circulation to provide a recovery benefit.

Another more commonly reported benefit of wearing compression garments is a decreased perceived muscle soreness (Dufield & Portas 2007; Jakeman, Byrne, & Eston 2010; Pruscino, Halson, & Hargreaves 2013; Ali, Cane & Snow 2008). This has several implications. First, the mechanism by which delayed onset muscle soreness occurs can cause a decrease in muscle force generation for up to two weeks. This can have effects on future performance if events are scheduled close together as well as the ability to perform workouts if maximal efforts are required. Jakemen, Byrne, and Eston (2010) added evidence to this recovery benefit with data showing that exercise performance benefited with compression garments worn in recovery. It must be noted, however, the study participants were active, exercising three times a week, but not well trained athletes. This leads to questioning if the gain was seen due to the training status, especially when coupled with the other cited studies that found decreased muscle soreness as the only benefit. Additionally, Dufield, Cannon, and King (2010) found that there were no differences in muscle twitch properties when the garments are worn for recovery, essentially showing that while the individual *feels* less sore, there is actually no change in performance . With this however, these still is a benefit if perceived soreness is decreased. Psychologically, an athlete may be better off. For instance, a stage racer may be more aggressive or have better planning in pre-race preparation if they are less sore. Additionally, the motivation to complete hard workouts can lack at times, especially with fatigue. Increased muscle soreness may affect adherence to an athlete's training plan. While, this benefit is not physiological or directly related to performance, it is still a benefit.

The extent to which these garments have been evaluated is well beyond the scope of these articles. Additional studies showing possible benefits have been published along with data further discounting the efficacy of compression garments in endurance athletes. Understanding the physiological mechanism of action as well as the population the compression stockings were originally applied to can assist a person in understanding why the use of the garments likely does not provide a benefit to healthy athletes.

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Quiz Questions

Name:
USAC #:
Email:

1. Which substance(s) are measured to detect muscle damage? Select all that apply.
    a. Creatine kinase
    b. Adenosine tri-phosphate
    c. Myoglobin
    d. Hemoglobin
    e. Hydrogen ions
    f. Lactic acid

2. A possible benefit of compression garments to athletes is:
    a. Increased time trial performance
    b. Increased function of the skeletal muscle pump
    c. Decrease perceived muscle soreness
    d. Increased speed of muscle function returning to baseline post-race

3. Compression garments aid immobile patients by:
    a. Increasing recovery of mobility
    b. Reducing the likelihood of clot formation
    c. Decreasing blood return to the heart
    d. Increasing recovery post myocardial infarction

4. Which athletes would receive a performance benefit by wearing compression garments during a race (select all that apply)?
    a. Cyclists
    b. Runners
    c. Triathletes
    d. Biathletes
    e. Duathletes
    f. None of the above

5. Cyclists competing in a multi-day stage race would likely see a performance benefit by wearing compression stockings for recovery.
    a. True
    b. False