

SPORT+MODE

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Special edition - Functional textiles

Research under pressure

Compression fabrics during and after sport are becoming increasingly popular. Brand manufacturers advertise that compression improves performance and recovery, amongst other things. Dr. Billy Sperlich of the German Sport University in Cologne sums up recent scientific findings.



Nowadays there are various types of compression fabrics for use in sports, ranging from socks through to full body suits

Compression fabrics have been highly successful for many years in clinical research. In particular, inactive and lying patients as well as travelers on long haul flights wear compression stockings to prevent thrombosis. For these groups of people, the stockings ensure a better flow rate in the venous system, lower venous back pressure and thus a higher venous return to the heart. These and other positive effects have prompted various companies from the sportswear industry to bring out compression garments specifically to increase sporting performance and improve recovery. They advertise a number of mechanisms of action, which are aimed at supporting the marketing of the various products: "increased oxygen supply", "reduced muscle oscillation", "less muscle wear and tear" and "greater endurance" are only a few of the advertising claims found on the Internet. But what are the mechanisms of action, and what scientific evidence is there relating to the benefit of compression garments in sport?

How does compression work?

As the name suggests, compression garments exert outside pressure on the muscles. This will improve blood flow to the muscles and the surround-

ing connective tissue. The prerequisite for an optimum supply of oxygen and nutrients to the muscles is an essentially steady blood flow. This is more difficult to achieve while standing upright, so several mechanisms have to assist the transport of blood back to the heart. This is important, because 85 percent of the total fluid volume in the body is found in the venous section. External mechanical pressure, for example from compression garments, causes a volume redistribution from the superficial into the deep venous system. This in turn increases the flow rate in the deep venous system. This effect is often equated with increased evacuation of metabolic waste products and a better local oxygen supply in the muscles, therefore an improved performance. During exercise (such as walking or jogging) there is an additional effect: located at regular intervals in the veins are the so-called venous valves. Operating in pairs, they prevent the blood from flowing back in the direction of the extremities which happens in between every heartbeat. At the same time the veins are being compressed through muscle contraction ("muscle vein pump"). This transports the blood volume from one venous valve to the next, in the direction of the heart. If this

mechanism is disturbed or overworked (by standing or sitting for long periods, for example), the veins become distended and the venous valves become insufficient (limited functionality). This gives the feeling of "heavy legs". Increased venous back flow to the heart ultimately means better boost potential in the heart itself and thus an increased supply of blood and oxygen in the periphery.

What has to be taken into account?

Based on the mechanisms of action mentioned, compression wear in sport is only useful if the pressure is anatomically adapted. This means that the compression is strongest in the ankle region and is steadily reduced over the knee up to the thigh. This is termed "graduated" compression. It is not yet clear which pressure is the optimum pressure. For compression socks or tights, a pressure range of around 20 to 30 mmHg at the ankle is regarded as optimum (1 mmHg is the static pressure a 1 mm mercury column develops).

"Compression textiles must be individually adapted"

Sperlich/Born

Regardless of the pressure, every compression textile should be made to measure. Some manufacturers adapt the clothing by height and weight, because unfortunately as yet there is no coherent standard. However, this can result in considerable differences in pressure. The findings of scientific studies on the subject of compression are often contradictory. This is a result of different study designs and study protocols, the performance level of the study subjects and the pressure applied. Nowadays, besides the classic compression socks, there are also

tights, shorts and full body suits with a compressive action on the market. There are also compression fabrics with "intermittent" compression. This means that there are various sizes of compressed surface. This is one of the reasons why the study results often vary. Differences can also be explained by the fact that many measured parameters (such as blood flow) can only be partially measured during maximum muscle contraction. Moreover, low numbers of study subjects, the lack of control groups and low effect sizes result in varying study results, which makes it harder to claim "effectiveness" for compression fabrics.

What evidence?

At this point a small (but important!) digression into statistical analysis might be permitted: experimental studies attempt to demonstrate the outcome or output (result) of the intervention ("wearing compression") against a control group ("wearing conventional clothes" or "naked") using statistical means. It is perfectly feasible that results are "significant" or even "highly significant". What does that mean? Well, differences between measured sizes or variables in statistics are referred to as significant. This means: the probability that the differences arise by chance is small. If significance is involved, statistically speaking this suggests that a difference does in fact exist. With the aid of statistics, a check is made to establish whether the intervention ("wearing compression") differs mathematically versus a control intervention. But: advertising messages such as "Wearing compression garments results in significantly enhanced performance" in no way have to signify anything for practice.



It is not yet clear whether compression textiles have an effect on endurance performance. They do appear to have positive effects on muscle strength and recovery

With the aid of an international database search, we analyzed 37 studies on the subject of "Sports and compression wear" from the last 20 years. The aim was to calculate the effect sizes between wearing with and without compression clothing and so compare the theoretical (and possibly practical) significance of the studies.

What do we learn?

According to our results, wearing compression clothing during sport appears to be beneficial if you:

- 1) want to improve maximum strength,
 - 2) want to increase sprint performance and
 - 3) want to increase jumping height.
- The results are very inconsistent if the person engaging in sporting activities:
- 1) wants to influence oxygen uptake and lactate concentration ("endurance" as it were) or
 - 2) wants to change the time until exhaustion ("stamina").
- These last two points in particular need further research in order to be able to make differentiated statements. The test participants also seem to have a subjective positive or negative perception of the exercise load, depending on the study design.

"It depends on what the athlete wants to achieve"
Sperlich/Born

If compression clothing is worn to stimulate recovery after sport, one should be aware of the following:

- 1) Recovery and stress markers in the blood behave differently depending on the study design (currently no statement possible).
- 2) The blood lactate concentration tends to be reduced faster while wearing compression gear (although whether this is a result of the compression itself or of raised skin temperature caused by the compression, is still unclear).
- 3) The body temperature increases when compression gear is worn.
- 4) Muscle pain and swelling are reduced by wearing compression gear.
- 5) Maximum jumping, sprint and power performance recover more quickly when compression gear is worn.

Conclusion and summary

So does compression work? Answer: It depends on what the athlete wants to achieve. You should be aware of the following points when considering the issue:

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- 1) There are different types of compression garments (socks, tights, shorts, full body suit). The individual benefit of each is not yet known.
- 2) Compression garments should be made to measure. As yet there is no consensus about the level of graduated pressure.
- 3) There is no scientific universal validity. Because of the different study designs, the data available is very variable. For every study there is effectively a counterstudy.
- 4) Compression garments appear to have a beneficial effect on sprint, jumping and maximum power performance.
- 5) The use of compression garments for endurance stress is not verified.
- 6) For recovery purposes, compression garments have a beneficial effect mainly on muscle pain and swelling. Faster recovery of maximum jumping, sprint and power performance and faster reduction of blood lactate are possible.
- 7) Other recovery and stress markers in the blood behave differently, depending on the study design.

Dr. Billy Sperlich und Dennis Peter Born