Compression and sports

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Compression material

SPORT STOCKINGS USING STIFF MATERIAL INCREASE THE EJECTION FRACTION OF THE CALF PUMP

H. Partsch, G. Mosti

Paris 2014

Behavior of different materials during exercise

- Conventional sport stockings do not increase calf pump function
- Venous narrowing in upright position is too small
- Stiff bands wrapped over the calf: 30-40 mmHg narrow deep veins and expell more blood volume with exercise
- Potential benefits (better performance, less fatigue etc) to be shown in future studies ???

- Stiff support of calf pump improves calf pump not only in CVI but also in healthy individuals
- Roman soldiers, Japanese postmen* used (stiff) leather gaiters for better performance
-

*Hirai M et al. Phlebology 2013;28:293

F Becker, Chamonix

Compression and sports

- **Rational in sports**
  - **Expected effects**
  - Improved performance and recovery
  - Blood flow acceleration
  - O2 supply to muscles, removing toxins
  - **Results of clinical trials**

RUGG S., STERNLICHT E., The effect of graduated compression tights, compared with running shorts, on counter movement jump performance
before and after sub maximal running. J Strength Cond. Res. 2013; 27(4):1067-73.

Compression and sports

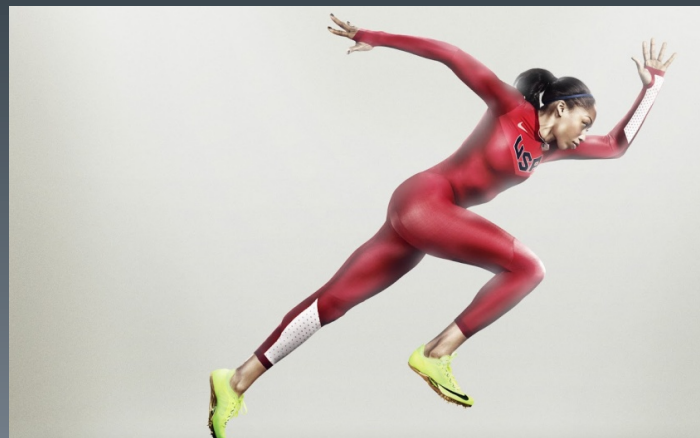
- **Performance**
  - **Jump after a run on a treadmill**
  - *Graduated compression vs no compression*

  - Vertical jump height increased
  - Less fatigue
  - Better comfort

1) DOAN BK., KWON YH., NEWTON RU., et al. Evaluation of a lower body compression garment. J Sports Sci. 2003; 21(8):601-610.
2) KRAEMER WJ., BUSH JA., NEWTON RU., et al. Influence of a compression garment on repetitive power output production before and after different type of muscle fatigue. Sports Med Training Rehabil. 1998; 8 (2):163-184
3) UFFIELD R., PORTUS M. Comparison of three type of full-body compression garments on throwing and repeat-sprint performance in cricket players. Br J Sports Med. 2007; 41(7):409-414.
4) FAULKNER JA., GLEADON D., McLAREN., JAKEMAN JR. Effect of lower-limb compression clothing on 400-m sprint performance. J Strength Cond. Res. 2013; 27(3):669-676.

Compression and sports

- **Performance**
- Sprint
  - Several studies
  - 60 m, successive sprints , 400 m
  - Sprint time: no improvement



KREMMLER W., von STENGEL S., KÖCKRITZC. et al. Effects of compression stockings on running performance in men runners.
J Strength Cond. Res. 2009; 23(1):101-105.

Compression and sports

- **Performance in endurance runners**
  - Only one positive study after a treadmill test
  - 18-20 mmHg below knee compression stockings vs no compression
  - Slight Improvement of performance in men runners (ns)
    - Velocity
    - Time
    - Lactates

1) SPERLICH B., HAEGELE M., ACHTZEHN S., LINVILLE J., HOLMBERG HC., MESTER J. Different types of compression clothing do not increase sub-maximal and maximal endurance performance in well-trained athletes.
J Sports Sci. 2010; 28(6):609-614.
2) HIGGING T., NAUGHTON GA., BURGESS D. Effects of wearing a compression garment on physiological and performance measures in a simulated game-specific circuit for netball. J Sports Sci. 2009; 12(1):223-226.
3) BERRY MJ. McMURRAY RG. Effects go graduated compression stockings on blood lactates following an exhaustive bout of exercise. Am J Phys Med 1987; 66(3):121-132.
4) SCALAN AT., DASCOMBE BJ. REABURN PR., OSBORNE M. The effects of wearing lower body compression garments during endurance cycling. Int. J Sports Physiol. Perform 2008; 3(4):424-438.

Compression and sports

- **Performance during an effort of endurance**
  - Cycling, running, netball
    - No significant improvement of performances
    - No significant improvement of O^2 consumption

DASCOMBE B.,LAURSEN P.,NOSAKA K., POLGLAZ E. No effect of upper body compression garments in elite-flat-water kayakers. Eur. J Sport Sci. 2013;13(4): 341-9.

Compression and sports

- **Performance in kayakers**
  - Compression garment covering the upper body
  - No effect

1) BORN DP. SPERLICH B., HOLMBERG HC. Bringing light into the dark: effects of compression clothing on performances and recovery. Int. J Sports Physiol. Perform. 2013; 8(1):4-18.

Compression and sports

- **Biological parameters**
  - During sports of endurance
    - No modifications
      - VO^2 max
      - Blood lactates
      - Partial pressure in O2

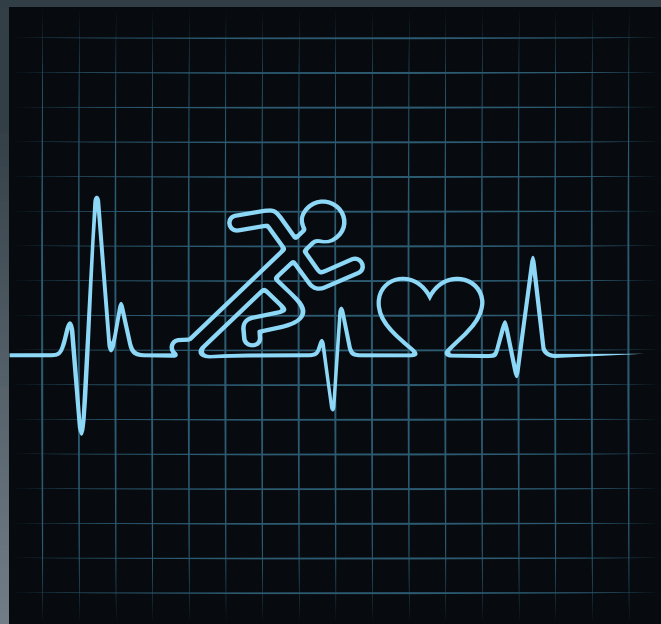
DASCOMBE BJ., HOARE TK., SEAR JA. et al. The effects of wearing undersized lower-body compression garments on endurance running performance. Int. J Sports Physiol. Perform 2011; 6(2):160-173.

MAC RAE B.A., COTTER J.D., LAING R. Compression garments and exercise, gar- ments considerations, physiology and performance. Sports Med 2011;41(10): 815-43.3.

SPERLICH B., HAEGELE M., KRÜGER M., et al. Cardio-respiratory and metabolic responses to different levels of compression during sub maximal exercise. Phlebotomy 2011;26(3):102-6.

Compression and sports

- Cardiovascular and respiratory function
  - A single positive study during exercise of endurance
  - Weak beneficial effect
  - O^2 consumption
  - Regional blood flow
  - Marginal benefit for +++ athletes
  - Five other studies are negative



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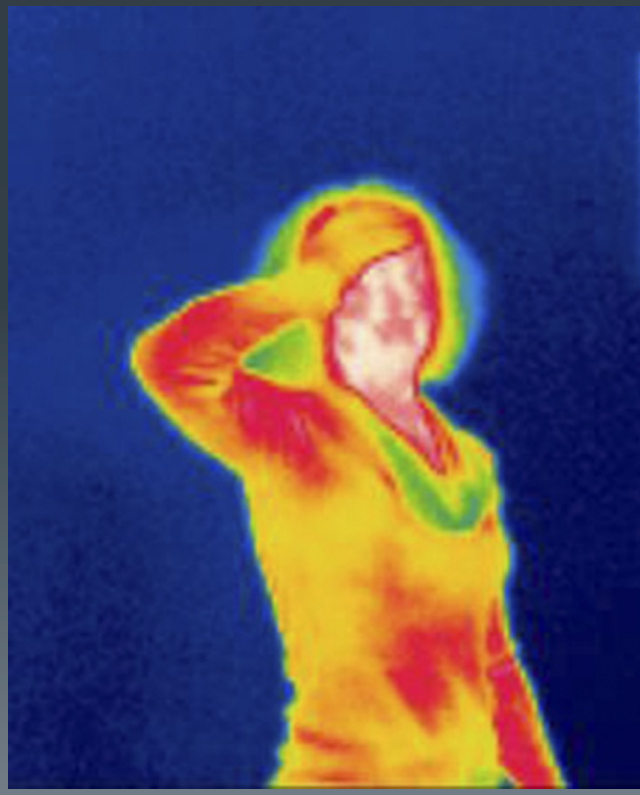
2) HIGGINGT.,NAUGHTONG.A.,BURGESSD. Effects of wearing a compression garment on physiological and performance measures in a simulated game-specific circuit for netball. J Sports Sci. 2009;12(1): 223-6.

3) HOUGHTON L.A., DAWSON B., MALONEY S.K. Effects of wearing compres- sion garments on thermoregulation during simulated team sport activity in temperate environmental conditions. J Sci. Med Sport 2009;12(2):303-9.

Compression and sports

- **Thermoregulation**
  - 3 studies
  - Increasing of skin temperature
  - No increasing of central temperature



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Compression and sports

- **Proprioception and muscular oscillations**
  - Improvement of proprioception
  - Skin receptors
  - Decrease in muscle oscillation during vertical jumps
  - Questionable during an endurance race ?

MAC RAE BA., COTTER JD., LAING R. Compression garments and exercise, garments considerations, physiology and performance. Sports Med 2011; 41(10):815-843.3

Compression and sports

- **And recovery…**

MAC RAE BA., COTTER JD., LAING R. Compression garments and exercise, garments considerations, physiology and performance. Sports Med 2011; 41(10):815-843.3

ALI A., CREASY RH. EDGE JA. The effect of graduated compression stockings on running performance. J Strength Cond. Res 2011; 25(5):1385-92.

Compression and sports

- Positive effects of compression
  - Feeling of fatigue
  - Swelling
  - Muscle pain +++
  - At one condition…
  - The compression has to be brought during exercise !

Compression and sports

- **Effects on post-exercise pain**
  - 24 - 72 hours after exercise
  - Benefit of the compression on the perceived level of pain
  - **Many positive studies in different sports**

JAKEMANNJR., BYRNE C., ESTON RG. Lower limb compression garment improves recovery from exercise induced muscle damage in young, active females. EUR. J Apple. Physio. 2010;109(6):1137-1144

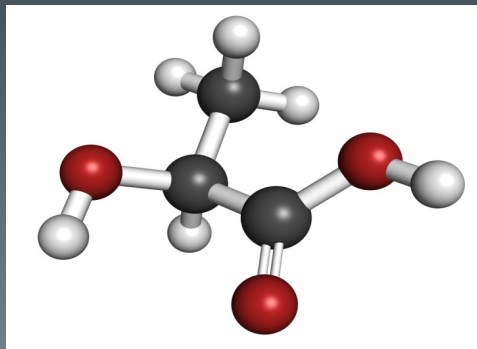
Compression and sports

- And on the **athletic performances after the recovery**
- Positive effects on jump height from 24 to 96 hours after strength exercises
- Wearing compression 12 hours after the first exercise

BERRY MJ. McMURRAY RG. Effects go graduated compression stockings on blood lactates following an exhaustive bout of exercise. Am J Phys Med 1987; 66(3):121-132.

Compression and sports

- **Elimination of muscular metabolites**
  - **Lactates**
    - Lactate kinetics after maximal exercise test
    - Compression 18 mmHg at the ankle and 8 mmHg at he calf during the effort and during the recovery phase
    - After 15 minutes: lower concentration / without stockings



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Compression and sports

- **Elimination of muscle lactate metabolites**
- **BUT ...**
- If stockings worn during the exercise and remove just after :
- Increase lactates
- Lactates would be retained in the muscle
- *Questionable results ???*

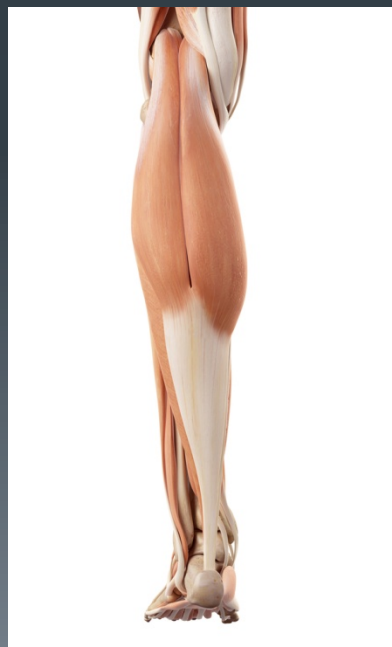
Xantal Borràs, Xavier Balius,Francheck Drobnic,Lluis Til, Antonio Turmo,Javier Valle
EFFECTS OF LOWER BODY COMPRESSION GARMENT IN MUSCLE OSCILLATION AND TISSULAR INJURY DURING INTENSE EXERCISE
Muscles Ligaments Tendons J. 2014 Feb 24;3(4):295-302.

Compression and sports

Muscular biopsy

- 40 min run under compression on one leg vs no compression on the other leg
- *Pressure unknown*
- *Biopsy after 2 days*

- Decreased muscular oscillations
- Less inflammatory muscular lesions



Lucas-Cuevas AG, Priego-Queseda JI et al
Effects of 3 weeks use of compression garments on stride and impact shock during a fatiguing run.
Int. J. Sports Med 2015 Sept; 36(10):826-31

Compression and sports

- **And during the training ?**

  40 runners

  Compression vs placebo for 3 weeks

  Training with CS reduced impact of acceleration on muscles (tibial peak acceleration)

  CS may play a protective role by reducing impact accelerations during running

Compression and sports

And for a marathon?

- Effect of compression stockings (18-21 mmHg) on muscular adaptation and recovery of the marathoners.

Allaert F.A., Gardon-Mollard C., Benigni J.P.
Phlébologie 2011, 64, 4 : 57-62

Compression and sports

- **Material and Methods**

- **Case control study** during the "Marathon de Paris".
- Compression stockings (18-21 mmHg) vs no compression
- 2 groups

  - CSG Compression Stockings Group
  - Case Control Group, CCG.
  - Doppler examination before and after the race
  - Self questionnaire at the arrival

    Visual Analogic scale from 0 to 100
  - **Follow up 4 days** after the arrival with VAS

Compression and sports

- **Material**

- 86 marathoners
- 43 runners in each group
- 2 groups strictly comparable

  (age, sex, BMI, diameter of the biggest internal gastrocnemius vein, experience of running marathons…)
- No CVD
- Bauerfeind supported this study

Compression and sports

- **Main results**
  - 90% completed the marathon in 4.4 hours, with no real difference between the 2 groups

p value <0.01

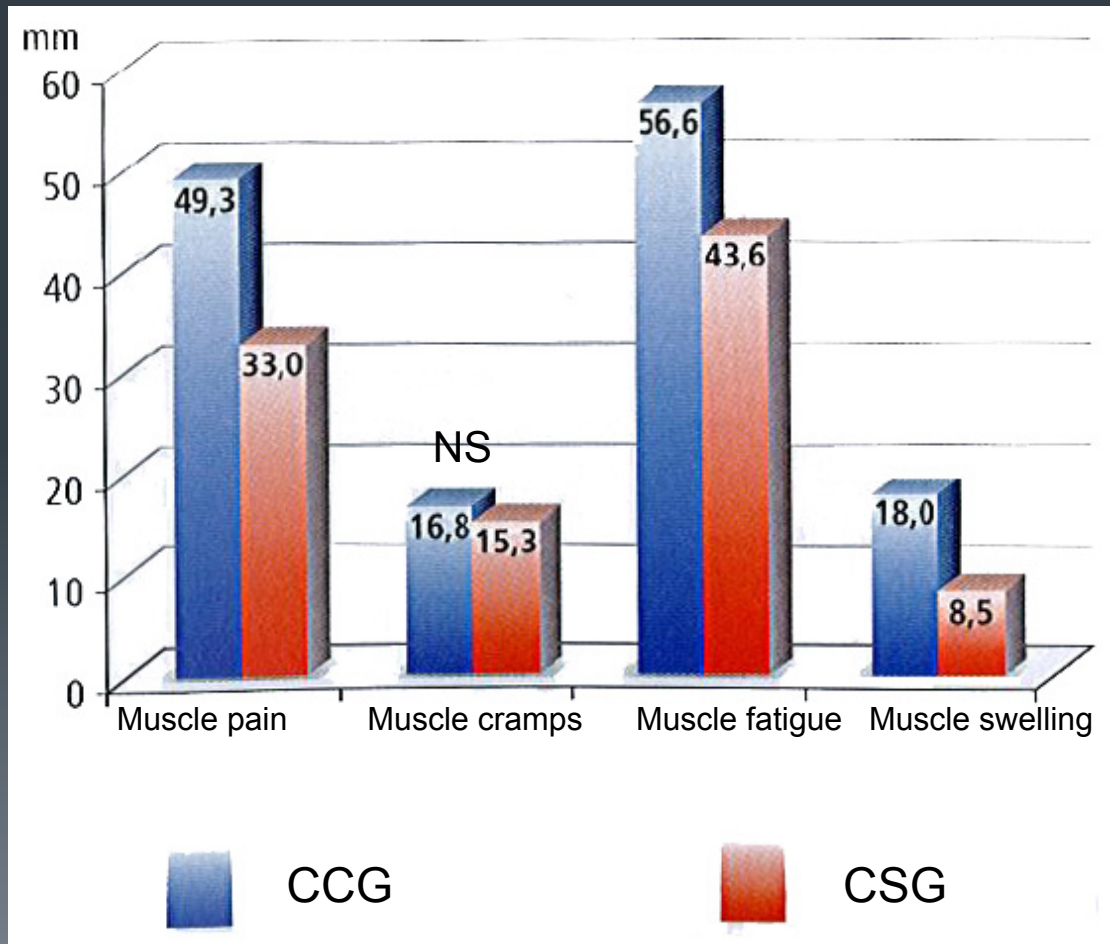
p value <0.01

Compression and sports

p value NS

p value <0.05

- **Main results**
  - At the arrival

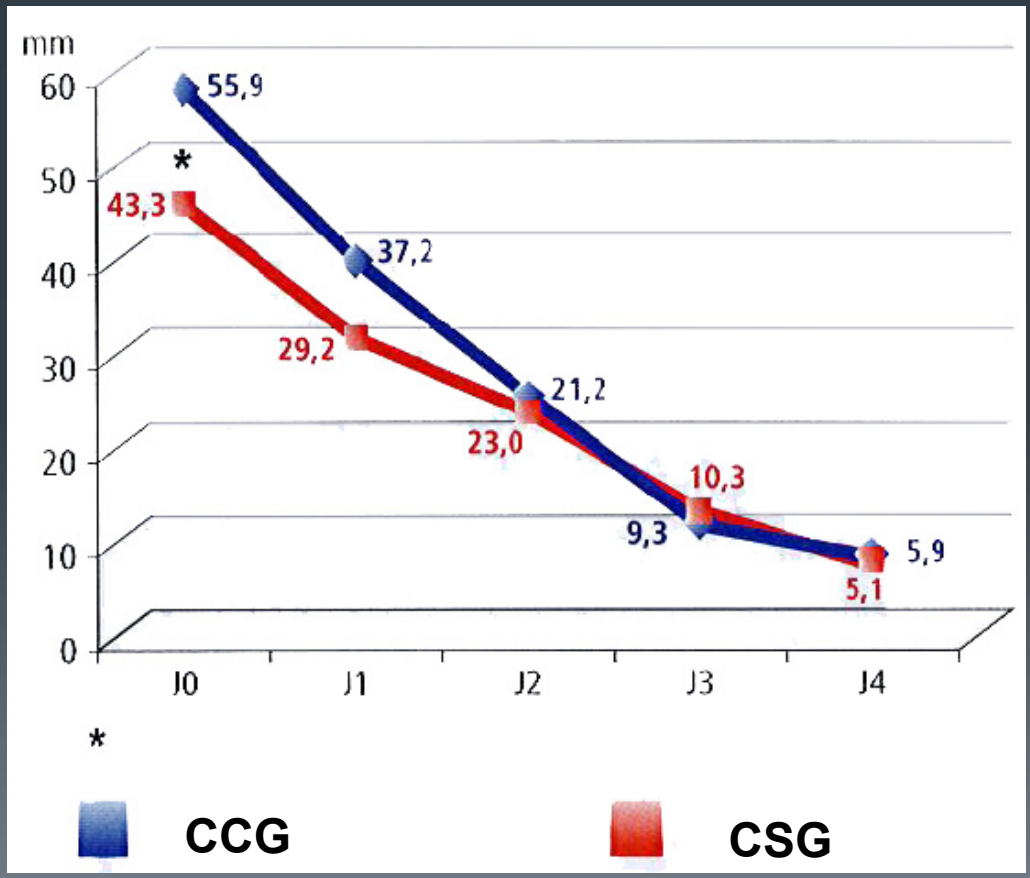


Compression and sports

- **Duplex**
  - Before the marathon, the diameter of the biggest internal gastroenemius vein was 5.3 ± 1.5 mm
  - At the arrival, the diameter of the same internal gastroenemius vein was lower in CSG
  - CSG : 5.1 ± 1.4 mm vs 5.7 ± 1.5 mm, $p < 0.05$.

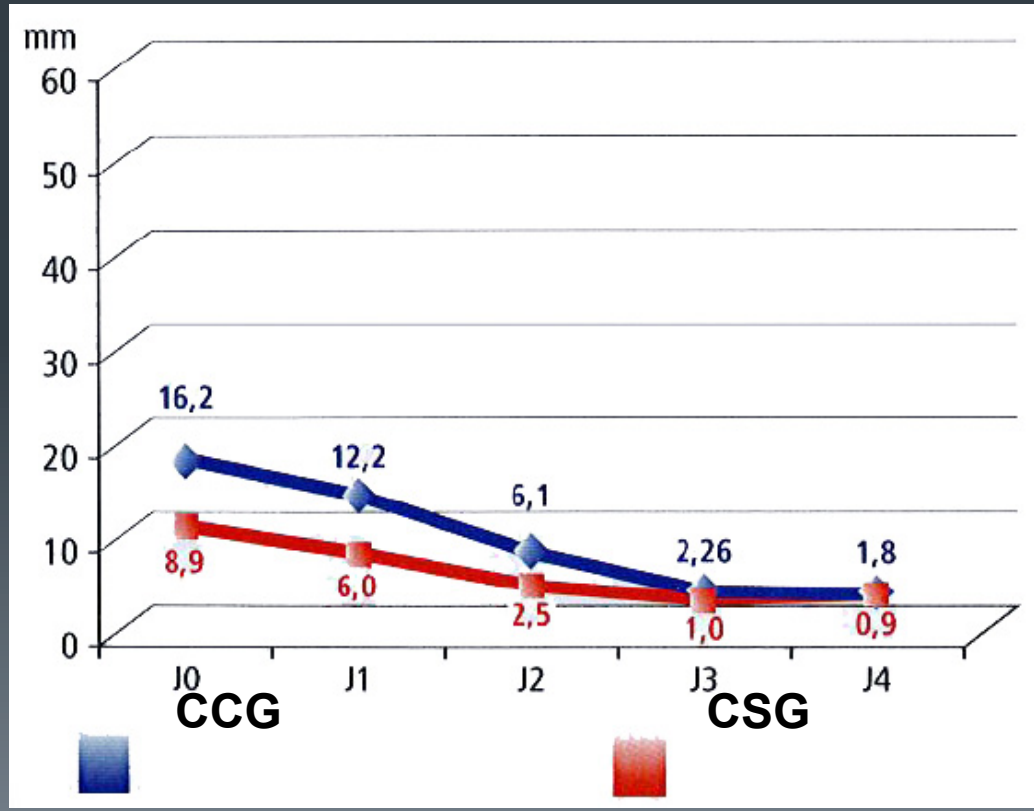
Compression and sports

- **Recovery**
  - Follow up at D4
  - Muscle fatigue



Compression and sports

- **Recovery**
  - **Follow up at D4**
  - Feeling of swelling



Compression and sports

- What can we conclude on the interest of compression?

Compression and sports

- **Placebo effect ?**
- **Sprint performance : 0**
- **Endurance Performance** : An impact
  - No effect on running times
  - Proprioception and muscle oscillations ++
  - Weak decrease of O^2 consumption +/-

Compression and sports

- **Recovery after endurance performance:** impact ++
  - If the compression is worn during and after exercise
  - Reduction of post-exercise pain
  - Less inflammatory muscular lesions
  - Increased venous flow ?

Compression and sports

- **Discussion**
  - **Benefits at the arrival and 2 days after**
    - How to explain the improvement of symptoms ?
    - Translation of better venous return during and after performance ?
    - Lower level of toxins around leg deep veins ?
    - Less muscular lesions due to the decrease of muscular oscillations ?

Compression and sports

- **Conclusions**
  - Wearing CS during endurance test improves recovery
  - Necessary to continue wearing CS during the recovery phase in order to maximize the effects (from 1.5 day or 2 days)
  - Less oscillations, less muscular lesions, less pain after endurance performance

Compression and sports

- **Conclusions**
  - New studies on material, mandatory
  - Experimental data on new stockings
    - Stiff stockings (8 mmHg or more)
    - Gradient
      - Degressive
      - Progressive +++
      - Constant ++

Compression and sports

- **Conclusions**
  - New clinical trials mandatory in amateur sportsmen or sportswomen (half marathon)
  - Not with professional
  - Lactic acid/toxins in situ
  - Muscular Biopsy
  - Air plethysmography
  - In recovery

Compression and sports

- Any questions ?

Les Cahiers
de la compression et de l'orthopédie

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