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

- **Results of clinical trials**

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

- Vertical jump height increased
- Less fatigue
- Better comfort
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- **Performance**

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

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- **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

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- Performance during an effort of endurance

- Cycling, running, netball
  - No significant improvement of performances
  - No significant improvement of $O^2$ consumption

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

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- Biological parameters

  - During sports of endurance
    - No modifications
      - \( \text{VO}^2 \text{ max} \)
      - Blood lactates
      - Partial pressure in O2

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


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- Proprioception and muscular oscillations
  - Improvement of proprioception
  - Skin receptors
  - Decrease in muscle oscillation during vertical jumps
  - Questionable during an endurance race?
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And recovery...
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- Positive effects of compression
  - Feeling of fatigue
  - Swelling
  - Muscle pain +++
  - At one condition…
  - The compression has to be brought during exercise!


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

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- 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 ???*

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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
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- 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
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And for a marathon?

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

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CCG</th>
<th>CSG</th>
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</thead>
<tbody>
<tr>
<td>Muscle pain</td>
<td>49.3</td>
<td>33.0</td>
</tr>
<tr>
<td>Muscle cramps</td>
<td>16.8</td>
<td>15.3</td>
</tr>
<tr>
<td>Muscle fatigue</td>
<td>56.6</td>
<td>43.6</td>
</tr>
<tr>
<td>Muscle swelling</td>
<td>18.0</td>
<td>8.5</td>
</tr>
</tbody>
</table>

- p value <0.01
- p value <0.05
- p value NS
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- **Duplex**
  - Before the marathon, the diameter of the biggest internal gastroenemius vein was $5.3 \pm 1.5 \text{ mm}$
  
  - At the arrival, the diameter of the same internal gastroenemius vein was lower in CSG

- CSG : $5.1 \pm 1.4 \text{ mm}$ vs $5.7 \pm 1.5 \text{ mm}$, $p < 0.05$. 
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- Recovery
  - Follow up at D4
  - Muscle fatigue
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- Recovery
  - Follow up at D4
- Feeling of swelling
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- What can we conclude on the interest of compression?
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- **Placebo effect ?**

- **Sprint performance : 0**

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

- New studies on material, mandatory
- Experimental data on new stockings
  - Stiff stockings (8 mmHg or more)
- Gradient
  - Degressive
  - Progressive +++
  - Constant ++
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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
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- Any questions?
5th Congress
World Union of Wound Healing Societies

WUWHS 2016
Florence
Italy

One Vision, One Mission