Postural adaptations of female elite Rock Climbers

Females « Climber’s back »

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Introduction

High level rock climbing & overhanging walls:

- Back and abdominal muscles heavily used
- Compressive forces on spine \(^1\)
- Lumbar pain \(^1, 2, 3, 4\)

- Biomechanical stresses on the spine
  - functional and postural adaptations \(^5\)

1. Burtscher and al; 1987
2. Folkl; 2013
3. Schweizer; 2012
4. Neuhof and al; 2011
5. Dalichau; 2001
Males...

- Increase of the spine curves in the sagittal plan
- Proportional to performance level
- Hyper-solicitation of pectoralis muscles

Förster and al; 2009
Question

Do female rock climbers present the same static and dynamic spine alterations?
Population

❖ 19 Elite rock climbers
  ‣ French and Swiss national team
  ‣ > 9 UIAA level
❖ 17 non-climbers
  ‣ Medicine faculty of Geneva
  ‣ Sport on a non-regular basis

❖ Inclusion criteria: female, > 18 years-old
❖ Exclusion criteria: Dorso-lumbar pain during the examination. Recreational or regular climber for the non-climbers group.
Spinal shape & mobility

Medimouse® (Idiag, Fehraltdorf, Suisse)

- Shape in upright, flexion and extension positions
  - Thoracic and lumbar curves
  - Segmental angles

- Mobility between maximal flexion and extension
  - Thoracic and lumbar movement amplitude
  - Segmental movement amplitude

- Precise, objective, reproducible, validated, reliable, noninvasive and non-irradiating

- Statistical differences: Unpaired Student’s t-test

1. Mannion and al; 2004
2. Post and al; 2004
Muscular length

- Muscular groups tested:
  - Pectoralis major
  - Iliopsoas
  - Hamstrings

- Jenda's protocol:
  - 0 = no shortening
  - 1 = minor shortening
  - 2 = major shortening

- Statistical differences:
  - “Cochran-Armitage test”

1. Janda; 2000
Pectoralis Major

Sternocostal part

Arm relaxed at 90° of abduction.
- Reach horizontal spontaneously $\rightarrow$ score 0
- With external help $\rightarrow$ score 1
- Not even with help $\rightarrow$ score 2

Abdominal part

Arm is relaxed at 160° of abduction.
- Spine of scapula spontaneously touches table $\rightarrow$ score is 0.
- With help $\rightarrow$ score 1
- Not even with help $\rightarrow$ score 2.
Hamstrings & Iliopsoas

**Hamstrings**

Hip is in passive flexion with knee in extension.

- Hip flexion reaches at least 90° -> scored 0
- 80° to 90° of flexion -> scored 1
- < 80° -> scored 2

**Iliopsoas**

- Hip extension > 0° -> score 0
- With vertical pressure on the knee -> score 1
- Not even with help -> score 2

Janda; 2000
Results - Spinal shape

Upright position:

- Reduced thoracic kyphosis
  ✓ Th1/2
  ✓ Th2/3

- Cranial displacement of thoraco-lumbar curves inflection point
  ✓ Th11-Th12

* p < 0.05. ** p < 0.01
Results – Spinal Shape

Flexion position:

- Decrease of thoracic kyphosis
  - Th2/3, Th5/6, Th6/7, Th11/12
- Increase of lumbar kyphosis
  - L1/2, L2/3, and L3/4

* p < 0.05. ** p < 0.01
Results - Spine mobility

Decrease of thoracic mobility
› Th4/5, Th5/6, Th6/7, Th7/8

Increase of lumbar mobility
› L1/2, L2/3, L3/4

*p < 0.05. **p < 0.01
Results - Muscular extensibility

- **Pectoralis major**: not significantly shortened
- **Hamstrings & Ilio-Psoas**: shortened (scores 1 and 2) on the left side
Discussion

Gender differences in climbers’ thoracic spine:

→ different climbing techniques?

* Lower muscular strength and muscle power
* Focus on technique
* More stretched positions, using maximum amplitudes -> highest possible point of wall.
  ✦ Dorsal muscles (latissimus dorsi, rhomboid and serratus anterior muscles) -> decrease of the thoracic kyphosis.
* No shortening of pectoralis major -> no increase of thoracic kyphosis.
* Bouldering vs lead climbing
Discussion

Shortening of hamstrings:

- Heeling technique: flexion of hip and knee + strong contraction of hamstrings.

- Physiologically more flexible -> lower muscular shortenings -> more limited impact on posture.

Lateralization on the left ...

- Right-handed?
Conclusion

Spinal adaptations of high-level female rock climbers different from male counterparts.

✓ Climbing technique
✓ Muscles morphology

Further studies are needed to:

✓ confirm results
✓ understand the mechanisms involved
✓ evaluate the pathological consequences
✓ provide evidence based prevention recommendations to the climbers


Thanks for your attention!