

## PSIG Research: Abstracts, Articles and Reviews

Every other month, the Pain Special Interest Group provides updates on new topics, new information and research related topics. Please feel free to submit a topic or research question to [dana-dailey@uiowa.edu](mailto:dana-dailey@uiowa.edu). If you would like to help in preparing information, please let me know as well.

Special thanks to Sam Fischer, SPT, CSCS for contributing articles to this month's research topic on Blood Flow Restriction (BFR) Training and Analgesic Effects. Sam received a Bachelor's Degree in Exercise Physiology with a minor in Coaching from Gustavus Adolphus College in MN and is currently a 3rd year DPT student at Mayo Clinic in Rochester, MN. His experience training athletes led him to research BFR as a training tool. His interest expanded to include the role of BFR in pain relief and rehab through patient care experiences.

**January 2019 Topic: Blood Flow Restriction (BFR) training and analgesic effects.**

### Bibliography

1. Ferraz R, Gualano B, Rodrigues R, et al. Benefits of resistance training with blood flow restriction in knee osteoarthritis. *Medicine and Science in Sports and Exercise* 2018;50: 897-905.
2. Korakakis V, Rodney Whiteley, Epameinontidis K. Blood flow restriction induces hypoalgesia in recreationally active adult male anterior knee pain patients allowing therapeutic exercise loading. *Physical Therapy in Sport* 2018; 32: 235-243.
3. Korakakis V, Whiteley R, Giakas G. Low load resistance training with blood flow restriction decreases anterior knee pain more than resistance training alone. A pilot randomized control trial. *Physical Therapy in Sport* 2018; 34:121-128.
4. Giles L, Webter K, McClelland J, Cook J. Quadriceps strengthening with and without blood flow restriction in the treatment of patellofemoral pain: a double-blind randomized trial. *British Journal of Sports Medicine* 2017; 51:1688-1694.

### Abstracts

1. Benefits of resistance training with blood flow restriction in knee osteoarthritis  
Ferraz R, Gualano B, Rodrigues R, et al.  
<https://www.ncbi.nlm.nih.gov/pubmed/29266093>

**Purpose:** Evaluate the effects of a low-intensity resistance training (LI-RT) program associated with partial blood flow restriction on selected clinical outcomes in patients with knee osteoarthritis (OA).

**Methods:** Forty-eight women with knee OA were randomized into one of the three groups: LI-RT (30% one repetition maximum [1-RM]) associated (blood flow restriction training [BFRT]) or not (LI-RT) with partial blood flow restriction, and high-intensity resistance training (HI-RT, 80% 1-RM). Patients underwent a 12-wk supervised training program and were assessed for lower-limb 1-RM, quadriceps cross-sectional area,

functionality (timed-stands test and timed-up-and-go test), and disease-specific inventory (Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC]) before (PRE) and after (POST) the protocol.

**Results:** Similar within-group increases were observed in leg press (26% and 33%, all  $P < 0.0001$ ), knee extension 1-RM (23% and 22%; all  $P < 0.0001$ ) and cross-sectional area (7% and 8%; all  $P < 0.0001$ ) in BFRT and HI-RT, respectively, and these were significantly greater (all  $P < 0.05$ ) than those of LI-RT. The BFRT and HI-RT showed comparable improvements in timed-stands test (7% and 14%, respectively), with the latter showing greater increases than LI-RT. Timed-up-and-go test scores were not significantly changed within or between groups. WOMAC physical function was improved in BFRT and HI-RT (-49% and -42%, respectively; all  $P < 0.05$ ), and WOMAC pain was improved in BFRT and LI-RT (-45% and -39%, respectively; all  $P < 0.05$ ). Four patients (of 16) were excluded due to exercise-induced knee pain in HI-RT.

**Conclusions:** Blood flow restriction training and HI-RT were similarly effective in increasing muscle strength, quadriceps muscle mass, and functionality in knee OA patients. Importantly, BFRT was also able to improve pain while inducing less joint stress, emerging as a feasible and effective therapeutic adjuvant in OA management.

2. Blood flow restriction induces hypoalgesia in recreationally active adult male anterior knee pain patients allowing therapeutic exercise loading.

Korakakis V, Whiteley R, Epameinontidis

<https://www.ncbi.nlm.nih.gov/pubmed/?term=Blood+flow+restriction+induces+hypoalgesia+in+recreationally+active+adult+male+anterior+knee+pain+patients+allowing+therapeutic+exercise+loading2>

**Objective:** To evaluate if a single blood flow restriction (BFR)-exercise bout would induce hypoalgesia in patients with anterior knee pain (AKP) and allow painless application of therapeutic exercise.

**Design:** Cross-sectional repeated measures design.

**Setting:** Institutional out-patients physiotherapy clinic.

**Patients:** Convenience sample of 30 AKP patients.

**Intervention:** BFR was applied at 80% of complete vascular occlusion. Four sets of low-load open kinetic chain knee extensions were implemented using a pain monitoring model.

**Main Outcome Measurements:** Pain (0-10) was assessed immediately after BFR application and after a physiotherapy session (45 min) during shallow and deep single-leg squat (SSLS, DSLS), and step-down test (SDT). To estimate the patient rating of clinical effectiveness, previously described thresholds for pain change ( $\geq 40\%$ ) were used, with appropriate adjustments for baseline pain levels.

**Results:** Significant effects were found with greater pain relief immediate after BFR in SSLS ( $d = 0.61$ ,  $p < 0.001$ ), DSLS ( $d = 0.61$ ,  $p < 0.001$ ), and SDT ( $d = 0.60$ ,  $p < 0.001$ ). Time analysis revealed that pain reduction was sustained after the physiotherapy

session for all tests ( $d_{(SSLs)} = 0.60$ ,  $d_{(DSLs)} = 0.60$ ,  $d_{(SDT)} = 0.58$ , all  $p < 0.001$ ). The reduction in pain effect size was found to be clinically significant in both post-BFR assessments.

**Conclusion:** A single BFR-exercise bout immediately reduced AKP with the effect sustained for at least 45 min.

3. Low load resistance training with blood flow restriction decreases anterior knee pain more than resistance training alone. A pilot randomized control trial.

Korakakis V, Whiteley R, Giakas G. <https://www.ncbi.nlm.nih.gov/pubmed/30268966>

**Objectives:** To evaluate if application of blood flow restriction (BFR) combined with low-load resistance training (LLRT) would induce significant anterior knee pain (AKP) reduction compared to LLRT alone.

**Design:** Randomised Controlled Trial.

**Setting:** Institutional physiotherapy clinic.

**Participants:** Forty males suffering from AKP were randomly allocated in the LLRT-BFR or LLRT group. BFR was applied at 80% of complete vascular occlusion. Four sets of open kinetic chain knee extensions were implemented in both groups using a pain monitoring model.

**Main Outcome Measures:** Pain (0-10) was assessed immediately after LLRT-BFR or LLRT application and after a physiotherapy session (45 min) during shallow and deep single-leg squat (SLS<sub>s</sub>, SLS<sub>D</sub>), and step-down test (SDT).

**Results:** Significant immediate pain reduction was found in LLRT-BFR group in SLS<sub>s</sub>, SLS<sub>D</sub> and SDT ( $d = 1.32$ ,  $d = 1.12$ ,  $d = 0.88$  respectively), but no difference was found in LLRT group. Following the physiotherapy session pain reduction was sustained in LLRT-BFR group in both SLS<sub>s</sub> and SDT ( $d = 1.32$ ,  $d = 0.78$ ,  $d = 0.89$  respectively). For the control group significant pain reduction was only found in SLS<sub>s</sub> ( $d = 0.56$ ). No significant between-group differences were observed.

**Conclusions:** The pain reduction induced by LLRT-BFR could indicate this intervention as a preconditioning process prior to the rehabilitation of AKP.

4. Quadriceps strengthening with and without blood flow restriction in the treatment of patellofemoral pain: a double-blind randomized trial

Giles L, Webster K, McClelland J, Cook J.

<https://www.ncbi.nlm.nih.gov/pubmed/?term=Quadriceps+strengthening+with+and+with+out+blood+flow+restriction+in+the+treatment+of+patellofemoral+pain%3A+a+double-blind+randomized+trial>

**Background:** Quadriceps strengthening exercises are part of the treatment of patellofemoral pain (PFP), but the heavy resistance exercises may aggravate knee pain. Blood flow restriction (BFR) training may provide a low-load quadriceps strengthening method to treat PFP.

**Methods:** Seventy-nine participants were randomly allocated to a standardised quadriceps strengthening (standard) or low-load BFR. Both groups performed 8 weeks of leg press and leg extension, the standard group at 70% of 1 repetition maximum (1RM) and the BFR group at 30% of 1RM. Interventions were compared using repeated-measures analysis of variance for Kujala Patellofemoral Score, Visual Analogue Scale for 'worst pain' and 'pain with daily activity', isometric knee extensor torque (Newton metre) and quadriceps muscle thickness (cm). Subgroup analyses were performed on those participants with painful resisted knee extension at 60°.

**Results:** Sixty-nine participants (87%) completed the study (standard, n=34; BFR, n=35). The BFR group had a 93% greater reduction in pain with activities of daily living (p=0.02) than the standard group. Participants with painful resisted knee extension (n=39) had greater increases in knee extensor torque with BFR than standard (p<0.01). No between-group differences were found for change in Kujala Patellofemoral Score (p=0.31), worst pain (p=0.24), knee extensor torque (p=0.07) or quadriceps thickness (p=0.2). No difference was found between interventions at 6 months.

**Conclusion:** Compared with standard quadriceps strengthening, low load with BFR produced greater reduction in pain with daily living at 8 weeks in people with PFP. Improvements were similar between groups in worst pain and Kujala score. The subgroup with painful resisted knee extension had larger improvements in quadriceps strength from BFR.