

# JACO

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# JACO

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**Abstracts and Literature Review**

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❖ Pope Z., Willardson J., Schoenfeld B.; **A brief review: exercise and blood flow restriction**; Reviewed by Brandon Steele DC, JACO 2015, 12 (3): 6-8.

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## Abstracts & Literature Review

### Blood Flow Restriction Exercise Stimulates Mtorc1 Signaling and Muscle Protein Synthesis in Older Men

Christopher S. Fry, Erin L. Glynn, Micah J. Drummond, Kyle L. Timmerman, Satoshi Fujita, Takashi Abe, Shaheen Dhanani, Elena Volpi, and Blake B. Rasmussen

JACO Editorial Reviewer: Neil L. Erickson, DC, DABCO, CCSP

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#### Author's Abstract:

Blood flow restriction exercise stimulates mTORC1 signaling and muscle protein synthesis in older men. *J Appl Physiol* 108: 1199–1209, 2010. First published February 11, 2010; doi:10.1152/jappphysiol.01266.2009.—

The loss of skeletal muscle mass during aging, sarcopenia, increases the risk for falls and dependence. Resistance exercise (RE) is an effective rehabilitation technique that can improve muscle mass and strength; however, older individuals are resistant to the stimulation of muscle protein synthesis (MPS) with traditional high-intensity RE. Recently, a novel rehabilitation exercise method, low-intensity RE, combined with blood flow restriction (BFR), has been shown to stimulate

mammalian target of rapamycin complex 1 (mTORC1) signaling and MPS in young men. We hypothesized that low-intensity RE with BFR would be able to activate mTORC1 signaling and stimulate MPS in older men. We measured MPS and mTORC1-associated signaling proteins in seven older men (age  $70 \pm 2$  yr) before and after exercise. Subjects were studied identically on two occasions: during BFR exercise [bilateral leg extension exercise at 20% of 1-repetition maximum (1-RM) with pressure cuff placed proximally on both thighs and inflated at 200 mmHg] and during exercise without the pressure cuff (Ctrl). MPS and phosphorylation of signaling proteins were determined on successive muscle biopsies by stable isotopic techniques and immunoblotting, respectively. MPS increased 56% from

baseline after BFR exercise ( $P < 0.05$ ), while no change was observed in the Ctrl group ( $P > 0.05$ ). Downstream of mTORC1, ribosomal S6 kinase 1 (S6K1) phosphorylation and ribosomal protein S6 (rpS6) phosphorylation increased only in the BFR group after exercise ( $P > 0.05$ ). We conclude that low-intensity RE in combination with BFR enhances mTORC1 signaling and MPS in older men. BFR exercise is a novel intervention that may enhance muscle rehabilitation to counteract sarcopenia.

**Background:** Resistance exercise training has been shown to be a beneficial intervention to protect against the effects of sarcopenia, with training studies showing increases in muscle protein synthesis and mass in both the old and young. However, the training studies often show a more robust muscle protein synthetic and strength response in the young than in the elderly.

**Methods:** The study included 7 elderly males who were randomly selected to the BFR or control groups. Health screening of the subjects included physical examination, stress test, laboratory tests, and ECG. D-Dimer blood tests were performed to predict the potential each subject had of developing thrombosis. The morning of the study a continuous infusion of phenylalanine was begun and maintained at a constant rate until the end of the experiment. A baseline strength test of one repetition leg (knee) extension was used to select the amount of weight to be used during the study. This value was 20% of the baseline amount. After a minimum of three weeks, the control group and the BFR group were switched so that all 7 subjects acted as both control and

active study participants. In addition to measuring for muscle protein (mTORC1) signaling, the study also evaluated plasma lactate, plasma glucose, cortisol, and serum growth hormone. Leg circumference and oxygen saturation were also measured.

**Results:** Increases in plasma lactate, plasma glucose, cortisol, serum growth hormone, and muscle protein.

**Conclusions:** In the BFR group, there was also a significant increase in the phosphorylation of S6K1 and rpS6, suggesting enhanced mTORC1 signaling following exercise with BFR. The enhanced mTORC1 signaling is indicative of improved translation initiation, which likely explains the increase in muscle protein synthesis with BFR.

**Clinical Relevance:** It is useful for an aging population to be trained in the exercise methods that will provide the greatest return on their limited abilities to perform exercise.

#### **JACO Editorial Summary:**

The article was written by authors from the Division of Rehabilitation Sciences, Departments of Physical Therapy and Internal Medicine, Sealy Center on Aging, University of Texas Medical Branch, Galveston, Texas; where the research was conducted and Department of Human and Engineered Environmental Studies, Graduate School of Frontier Sciences, University of Tokyo, Chiba, Japan

- The purpose of the study was to measure the increase in muscle protein synthesis in blood flow

- restricted muscles subjected to exercise.
- Finding an exercise method that the elderly population can and will perform that gives maximum benefit for the maintenance of mobility would be a remarkable discovery.
  - The investigative researchers reported that muscle protein synthesis increased by 56% in the BFR group 3 hours after performance of a bout of low-intensity resistance exercise with BFR, while muscle protein synthesis did not increase in the Control group, who exercised without BFR.
  - The test group showed increases in plasma lactate, plasma glucose cortisol, growth hormone leg (thigh) circumference, and most importantly muscle protein synthesis.

## Summary

There was some confusion during the initial reading of the article as it appeared that the “Infusion study 1” was a different group than the “BFR group”. Another area of confusion was how the researchers got arterialized blood from a vein. In the future the authors could be more succinct in referring to the thigh and leg (the portion below the knee) and the assignment of either flexion or extension at a joint (hip or knee) rather than the leg.

The idea of assisting the aging population with increased independence and lowered risks of disability is an admirable goal. However the methods studied in this case raise a number of concerns.

I tested the pain tolerance to the thigh pressure cuff of a number of patients in my office. I used an extra-large blood pressure cuff on the thigh of several patients who, without exception, reported significant pain when inflation reached the neighborhood of 160mm/Hg. I have difficulty accepting that the researchers used 200mm/Hg for a 4-5 minute period of time.

Cortisol is a hormone released in response to stress and it was found to be elevated in the test subjects. The researchers gave no explanation for this increased lab value. Increased cortisol inhibits the uptake of amino acids into the muscle cells, making it nearly impossible to fuel muscle cells and grow muscle. Two IV catheters were placed in each participant along with anesthesia for 5 muscle biopsies and the above mentioned pressure cuff for 4-5 minutes. Although the authors reported that “Subjects did not report any side effects immediately after exercise or 1 week after the infusion protocol” I am doubtful. Plasma lactate levels were increased after exercise in both the control and study group. While plasma lactate and lactic acid are not the same thing, my experience has shown that strenuous exercise will cause sore muscles in the 2-4 day period afterwards. Is it possible that the increased cortisol found in the subjects was a factor of pain and stress?

Knowing that all subjects were in both the test and control groups, I find it

unusual that the researchers did not discuss the lowered baseline oxygen saturation in the test group.

Of the 18 proteins addressed in this study, 4 increased in both the study and control groups. It can well be said that the

increases in the study group were greater, but for me, the degree of inconvenience of using the pressure cuff during exercise and potential discomfort associated therewith, is too great to justify its use, especially in the elderly patient.



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 May 5, 2015—Atlanta, GA  
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 TBA—Halifax, Canada (CE)  
**More dates/locations on the website.**

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 May 2, 2015—Palmer San Jose Homecoming  
 June 6-7, 2015—UWS Portland—12 hours

## Exercise and Blood Flow Restriction

Zachary K. Pope, Jeffrey M. Willardson, Brad J. Schoenfeld  
Journal of Strength and Conditioning Research  
Publish Ahead of Print

JACO Editorial Reviewer Brandon Steele DC

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### Author's Abstract

**Background:** Traditional understanding of exercise suggests moving heavy a load with high intensity is the most efficient way to induce muscle hypertrophy. There is a growing amount of evidence to suggest low intensity exercise with a blood flow restriction devices can also increase muscular strength and hypertrophy. Blood flow restriction (BFR) is achieved via the application of external pressure over the proximal portion of the upper or lower extremities. Restriction of the upper or lower limb venous return can affect the neural, endocrine, and metabolic pathways thereby inducing desired muscular responses. A full detail of such responses and exercise suggestions are presented in this article.

**Conclusions:** Muscular hypertrophy and strength are observed at considerably lower intensities (20% to 50% of 1-RM) than typical resistance training when combined

with BFR. Utilization of BFR exercise may be better suited for populations that cannot tolerate high intensity resistance training. Prescriptive exercise variables for clinical populations are not yet definable; but in healthy populations, BFR exercise may provide an alternative means of obtaining a hypertrophic effect in a relatively short time period.

### JACO Editorial Summary

- The authors present the most current literature concerning the acute responses and chronic adaptations associated with BFR exercise.
- The purpose of the paper was to compare the acute and chronic responses of muscle associated with both BFR and non-BFR exercise.

- BFR exercise requires pressurized cuffs or elastic bands to compress the proximal portion of the lower extremity (inguinal crease) or upper extremity (distal to the deltoid muscle) during exercise. External pressure must be sufficient to maintain arterial inflow while occluding venous outflow of blood distal to the occlusion site (50-250 mmHg). Exercises are performed at low intensity with short intervals between sets.
- Strength and hypertrophic adaptations may take place in muscles proximal or distal to the occlusion site. For example: occlusion of the arm distal to the deltoid during bench press exercises may elicit hypertrophy of the triceps brachii (distal to occlusion) and/or pectoralis major (proximal to occlusion).
- Current research demonstrates increased muscular strength, hypertrophy, improved localized endurance, increase VO<sub>2</sub> max, up-regulation of angiogenesis, activation of fast twitch muscle fibers, local decrease in intramuscular pH, and release of growth hormone via BFR exercise.
- Cell swelling from reactive hyperemia may be a common mechanism induced through BFR exercise to stimulate muscular adaptation. Intracellular swelling stimulates protein synthesis and decreases proteolysis thereby promoting an anabolic response.
- Practitioners should be concerned over the potential risks associated with altered cardiovascular function during BFR exercise. For example: patients with low cardiovascular risk factors may walk with bilateral BFR at the inguinal crease while other patients may perform isolated knee extensions to lower cardiovascular demands during exercise.
- Potential side effects include, but are not limited to: cerebral anemia, venous thrombus, pulmonary embolism, rhabdomyolysis, deterioration of heart disease, subcutaneous hemorrhage, numbness and cold feeling. The incidence of significant side effects remains small affecting <1% of patients performing BFR exercises.
- The application of BFR exercise may be best suited for populations that cannot tolerate the large mechanical loads imposed during high intensity resistance training. This type of exercise may provide an alternative means of obtaining a hypertrophic effect on muscles in a relatively short time period.
- Exercise prescription will vary dependent on patient goals. It may be performed everyday or as few as 2-3 sets per week. Time under

occlusion will attenuate metabolite accumulation. Alternating agonist/antagonist movements with continuous BFR may also be utilized.

## **Summary**

The results from this journal highlight the complexity of the rehabilitation options chiropractic physician's encounter on a daily basis. Blood flow restriction exercise may be another tool in the toolbox

for those patients requiring muscle hypertrophy as a part of their treatment. Clinicians should be cognizant of potential side effects mostly affecting the cardiovascular system. This exercise may be a treatment option to achieve optimal clinical results for the right patient. I would like to see more information on specific exercise prescription and protocols as evidenced in the literature; however, research on BFR exercise is limited at this time.



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## Radiology Corner

### Trauma Case Imaging

Cliff Tao DC, DACBR

Published:

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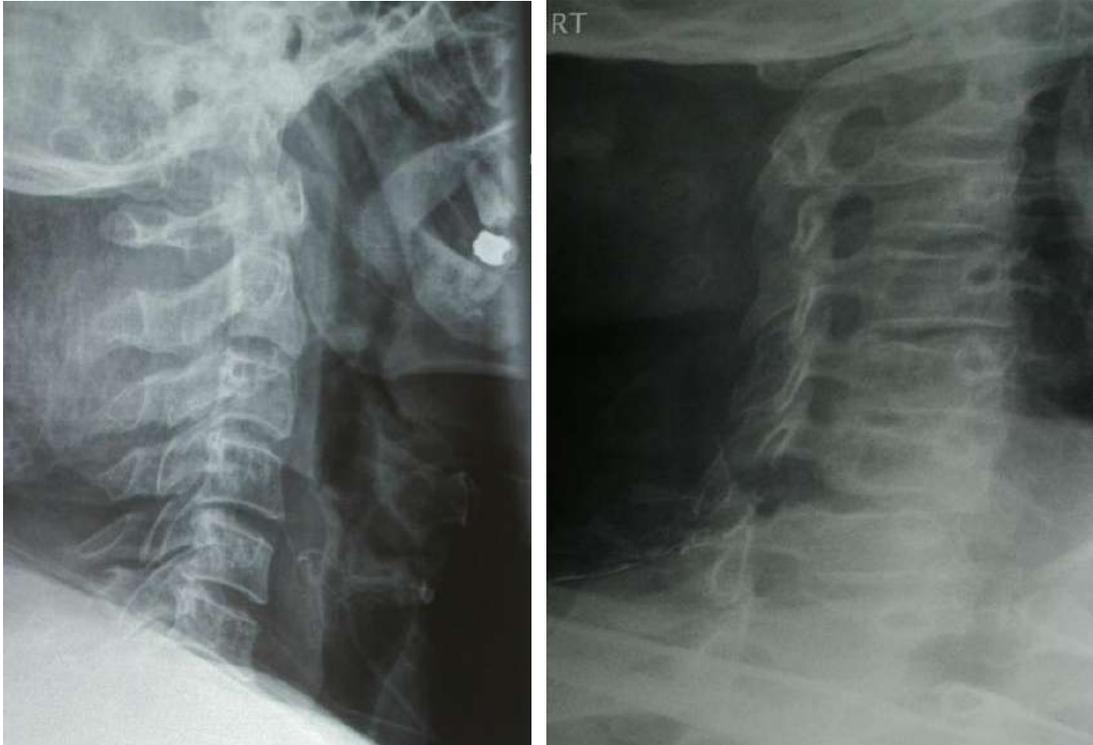
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This is a 52 year old male with severe neck pain, right greater than left after flexion/extension/rotation injury in a recent motor vehicle accident. Severe loss of active and passive ranges of motion. No reported loss of consciousness. No neurologic

findings. Hospital x-rays of the cervical spine including oblique views were brought in by the patient for your evaluation. Image quality is suboptimal because of soft neck collar. What are the radiographic findings?





1. Right C6 facet fracture.
2. Very mild degenerated disc and uncovertebral joints at C5/6, producing bilateral neuroforaminal stenosis.
3. Mild posterior spondylosis at C4/5 and C5/6, probably compatible with disc herniation.
4. Hypolordosis.
5. Pronounced head rotation on the lateral view, probably positional.

This case demonstrates the importance of taking multiple views of a body region in trauma cases. The facet fracture is seen only visible on the right anterior oblique view. This is not a common fracture, but it is commonly missed (1). The patient's severe loss of ROM precluded flexion/extension views, but generally those would also be an appropriate addition to the standard cervical spine x-ray series.

The treatment of unilateral cervical facet fracture is controversial, and generally either involves non-operative treatment with immobilization, or fusion. Magnetic

resonance imaging and/or computed tomography may be useful, but is generally not clinically indicated.

1. Kalayci M Cağavi F Açikgöz B. Unilateral cervical facet fracture: presentation of two cases and literature review. *Spinal Cord* 42(8):466-72, 2004.



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## Current Events

### Letter to the Editor-In-Chief

Here is a request I received from one of our readers. My response has remained strictly with the coding issue and I have enlisted one of the members of our Editorial Review Board for some specific answers. I intentionally did not address any other problems at this time as I did not want to miss the point of this request.

“Dear Dr. Gundersen,

I have been working on the ICD-10 conversion with great concern. I have even taken some web-seminars on how to do it but I think I am missing a lot. Would you mind using the expertise of your journal to help me solve some dilemmas?

Here is my narrative diagnostic statement:

Acute traumatic lumbar  
intervertebral disc syndrome grade 2  
with paravertebral splinting, sciatic  
radiculopathy and subluxations at  
C2-3, C5-6-7, T4-5, L4-5, S-1-2,  
right posterior innominate.

Here are my old codes from ICD-9:

CODES: 722.73 355.9 728.85 724.3  
729.1 724.9 739.1, 739.2, 739.4,  
739.3, 739.0

Here are the two codes from ICD-10  
I think equate to this:

M51.17 Intervertebral disc  
disorder with radiculopathy

M54.16 Radiculopathy  
lumbosacral region

My questions are:

1. Do I need to list the subluxation codes now as I did before?
2. Do I need to also list the lumbar pain codes (lumbalgia) like I used to?
3. Am I on the right track?

Thanks for your help."

There are several members of our Editorial Review Board who have expertise in this area. I have asked Dr. Evan Gwilliam to provide some pointed answers to this example with the hope of being responsive to our readers and to offer another avenue for help. He has graciously obliged. Here are his comments:

1. If you needed to report the "subluxation" codes in ICD-9, you will continue to report them in ICD-10. The most likely ones for this scenario are segmental and somatic dysfunction (but it is suggested that you document "segmental dysfunction" rather than just "subluxation" because that phrase better matches the codes we expect payers to like)

- M99.00 head
- M99.01 cervical
- M99.02 thoracic
- M99.03 lumbar
- M99.04 sacral
- M99.05 pelvic

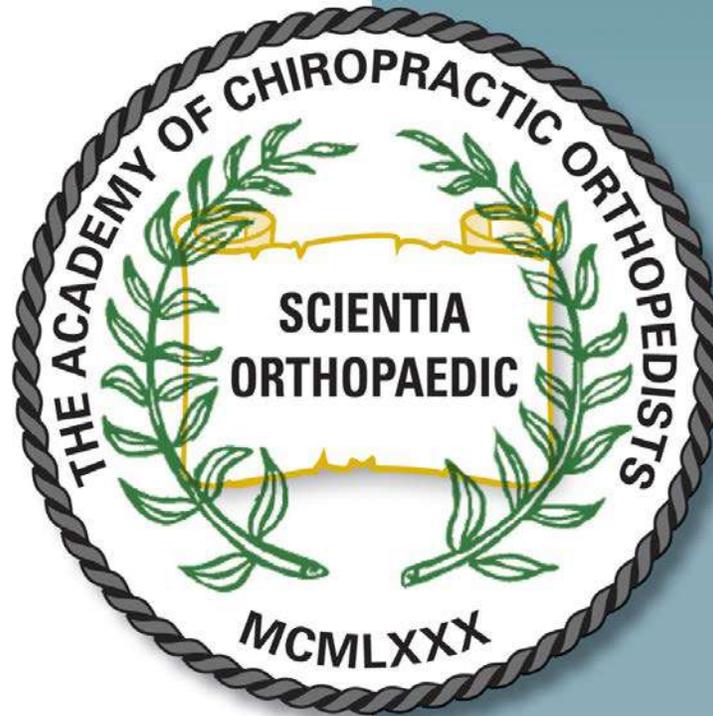
But please note that your subjective and objective findings need to clearly support medical necessity for each of these regions, especially if you are billing a 98942.

2. You would list the lumbar pain codes, like you used to, but only if they are not, in your clinical opinion, routinely associated with any other diagnosis you are reporting for this encounter. For example, you would not report lumbalgia when the patient also has a lumbar strain because everyone agrees that the strain already includes low back pain. But I think it is appropriate to report it along with the disc codes.
3. To be honest, you are not on the right track. The two codes you have chosen are mutually exclusive of each other. They should not be reported together because, in the tabular list, they list each other under the "excludes1" note. And, conceptually, this makes sense. M51.17 contains the information

about the disc and the radiculopathy, so there is no reason to report the M54.16.

Furthermore, your diagnostic statement does not contain enough information to support several of your ICD-9 codes, much less the extra details specified by ICD-10. Keep in mind that more codes does not mean that the case is more payable. Especially if the documentation does not support them. If you improved your diagnostic statement a little more, you could also add M62.830-muscle spasm of back. But consider documenting that phrase instead of "splinting" because your choice of words should match the codes to remove all doubt.

This answer was provided by Dr. Gwilliam of the ChiroCode Institute. Please visit [ChiroCode.com](http://ChiroCode.com) for more ICD-10 and documentation help.



The Journal of the Academy of Chiropractic Orthopedists welcomes your comments on these and any other issues you wish to provide feedback on.

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