MONTHLY

THE S&C RESEARCH REVIEW

By Chris Beardsley

AUGUST 2019 EDITION

August 2019 Edition

Editorial by Chris Beardsley

Welcome to the August 2019 edition! This month, the main theme was definitely one of recovery. One important study compared the rates of recovery after a workout involving either the back squat, the bench press, or the deadlift (since the conventional wisdom is that the deadlift takes longer to recover from). Another study assessed the difference in recovery rates between normal, moderate load strength training and light load strength training with blood flow restriction (BFR). And yet one more study assessed what actually happens if we train too frequently. While admittedly in rodents, the findings of this final study provide a crucial warning.

Although the main theme was recovery, the studies covered in this month's hypertrophy section are no less exciting. Indeed, you will likely have seen the research being discussed at length on social media. As always, I have fairly unique perspectives to share on many of these studies. For example, I believe that with the arrival of the two new studies that have been published recently, there is now a good (and easily identifiable) explanation for the very widely varying findings that can be observed regarding the dose-response of training volume on muscle growth. Read on in the edition to learn more!

For the athletic performance section this month, I managed to find a track and field sprinting study that I really wanted to talk about. The study covered in this edition was a great opportunity to discuss the relationship between different types of strength and sprinting ability, and also reported data indicating that technique may be less important than many coaches would have you believe (at least once you reach the higher levels of the sport). An ability to produce force [1] at high speeds, and [2] eccentrically seem to be the most important things. Read on in the edition to learn more! See you next month.

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Is muscle damage less after light load training with blood flow restriction?

One of the benefits that has been proposed for light load training with blood flow restriction (BFR) is that it might cause less muscle damage than normal strength training. This idea seems to have become popular in part due to misunderstandings regarding [1] how muscle damage is really caused, and [2] how mechanical tension is produced in muscular contractions. In fact, owing to the greater peripheral fatigue that is often present during light load strength training, we might anticipate more muscle damage after light load strength training with BFR, rather than less.

Key findings

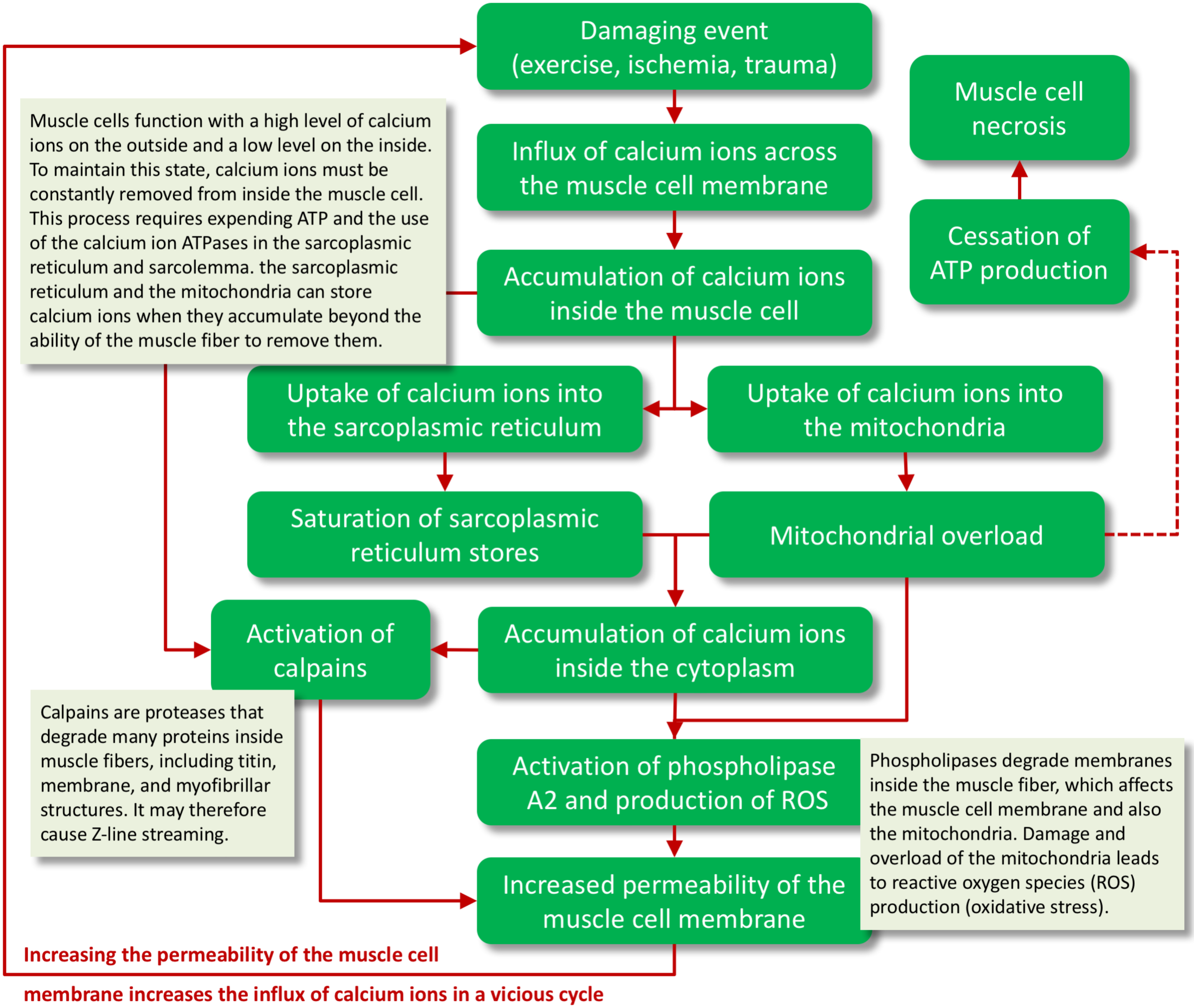
In untrained females, the rate of strength recovery is similar after workouts involving the same number of sets to failure with moderate loads (70% of 1RM) and light loads (20% of 1RM) with blood flow restriction (BFR). This suggests that the two workouts caused similar muscle damage. Even so, light load training with BFR caused more delayed onset muscle soreness (DOMS) than moderate load training.

Practical implications

Using light load strength training with blood flow restriction (BFR) is unlikely to allow faster recovery from a workout, and may in fact cause recovery to occur more slowly. Thus, we should not program a higher training frequency when using light load strength training in conjunction with BFR, compared with normal, moderate load strength training.

Muscle damage responses to resistance exercise performed with high-load versus low-load associated with partial blood flow restriction in young women. Alvarez, I. F., Damas, F., Biazon, T. M. P. D., Miquelini, M., Doma, K., & Libardi, C. A. (2019). *European Journal of Sport Science*, 1-10

Excessive accumulation of calcium ions in the muscle cell leads to the loss of control over cytoplasmic calcium ion levels, and subsequently muscle fiber damage



Derived from: Gissel, H. (2006). The role of Ca2+ in muscle cell damage. *Annals of the New York Academy of Sciences*, *1066*(1), 166-180.

OBJECTIVE

To compare the rates of recovery from muscle damage after traditional, moderate load strength training and light load strength training with blood flow restriction (BFR), in untrained young females.

INTERVENTION

Subjects did 2 workouts, 2 weeks apart. One workout involved traditional, moderate load strength training (TRAD) and the other workout involved light load strength training with BFR (LIGHT). TRAD comprised 4 sets of single-leg knee extensions (through a 90° range of motion [ROM]) with 10 – 12RM (approximately 70% of 1RM), with 1 minute of rest between sets, and using 2-second concentric and eccentric tempos. LIGHT comprised 4 sets of single-leg knee extensions (through a 90° ROM) with 1 minute of rest between sets, and using 2-second concentric and eccentric tempos. The first set involved a 30 – 35RM and the other 3 sets involved a 15 – 18RM (in all cases, approximately 20% of 1RM).

POPULATION

10 untrained females, aged 22 ± 2 years

MEASUREMENTS	RESULTS
Maximum strength: By maximum voluntary isometric contraction (MVIC) knee extension torque at 60° knee angle, and maximum voluntary concentric contraction (MVCC) knee extension torque at 60°/s angular velocity, in an isokinetic dynamometer at baseline and also at 24, 48, 72, and 96 hours post-workout.	MVIC was significantly reduced post-workout both at 24 hours after TRAD (91.6%) and LIGHT (87.6%) and also at 48 hours after TRAD (96.1%) and LIGHT (90.1%) with no significant differences in the reductions between the two workouts. Conversely, MVCC was significantly reduced post-workout only at 24 hours after TRAD (96.7%) and LIGHT (91.3%), with no significant differences in the reductions between the two workouts. Baseline strength was defined as 100%.
Delayed onset muscle soreness (DOMS): By a visual analogue scale, after getting up from a chair without using upper limbs.	LIGHT displayed significantly increased DOMS at 24 and 48 hours compared to baseline, while TRAD did not.
Joint ROM: By the difference between flexed and extended knee joint angles.	Joint ROM did not change significantly after either TRAD or LIGHT at any time.
Muscle architecture: By muscle thickness (MT), echo intensity (EI) and pennation angle (PA), using ultrasound images of the vastus lateralis (VL) and rectus femoris (RF).	In TRAD and LIGHT, VL MT was significantly increased at 24 and 48 hours, while RF MT was significantly increased at 24, 48, and 72 hours. In TRAD and LIGHT, VL EI was significantly increased at 24, 48, and 72 hours, while RF MT was significantly increased at 24, 48, 72, and 96 hours. In TRAD and LIGHT, VL PA and RF PA were significantly increased at 24, 48, and 72 hours. There were no differences between workouts.

SUMMARY

In untrained females, the rate of strength recovery is similar after workouts involving the same number of sets to failure with moderate loads (70% of 1RM) and light loads (20% of 1RM) with blood flow restriction (BFR). This suggests that the two workouts caused similar muscle damage. Even so, light load training with BFR caused more delayed onset muscle soreness (DOMS) than moderate load training.

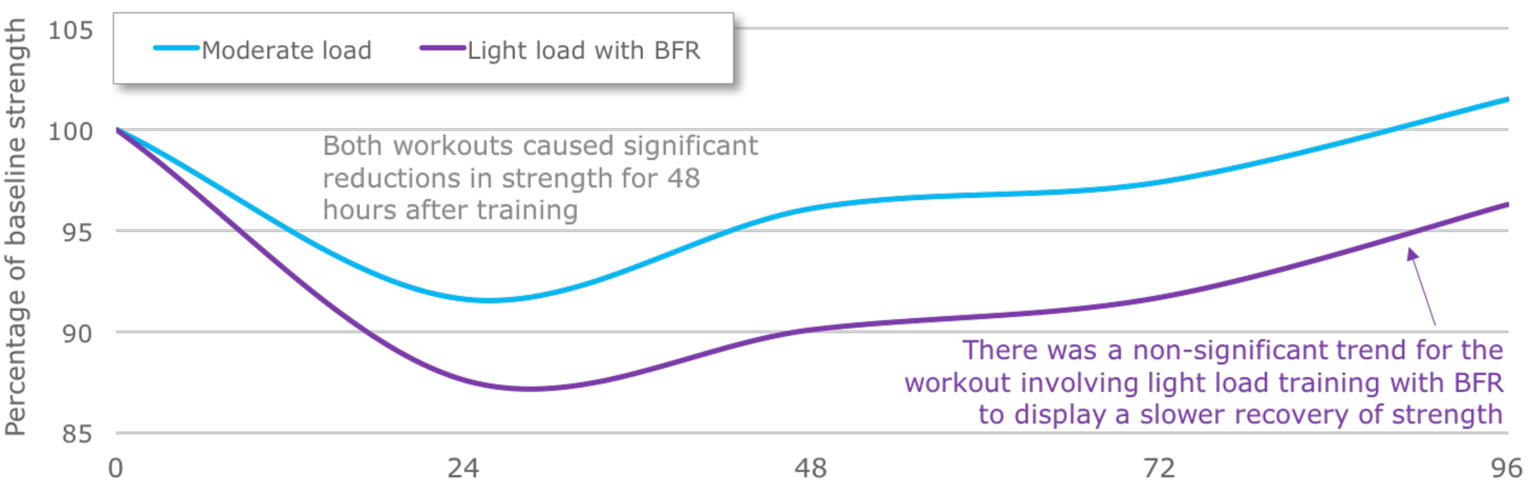
This study reported that the rate of strength recovery is similar after workouts involving the same number of sets to failure with moderate loads (70% of 1RM) and light loads (20% of 1RM) with blood flow restriction (BFR). This suggests that the two workouts caused similar muscle damage. Even so, light load training with BFR displayed a non-significant trend towards greater reductions in strength than the moderate load workout, and also caused a more noticeable level of delayed onset muscle soreness (DOMS).

In contrast to this study, previous research into the muscle-damaging effects of light load strength training in conjunction with BFR has been conflicting. Some research has identified clear signs of muscle damage (1 – 4), while other studies have indicated that muscle damage is minimal (5 – 8).

It is often assumed that light load strength training in conjunction with BFR might cause little muscle damage, since the level of mechanical tension is low. This idea is incorrect for two reasons.

Firstly, the level of mechanical tension produced and experienced by muscle fibers is determined not by the external weight on the bar, but by the force-velocity relationship. Also, when training under fatiguing conditions (as when working to failure), the proximity to failure determines bar speed (9). Thus, sets with different external loads involve identical levels of mechanical tension on the final few reps, when they are done with the same number of reps in reserve or to failure. Different muscle damage responses between sets using different loads therefore cannot be explained by differences in mechanical tension.

Maximum **isometric** strength during the 96 hours of recovery from a traditional, moderate load workout and a light load workout with blood flow restriction (BFR), in untrained females

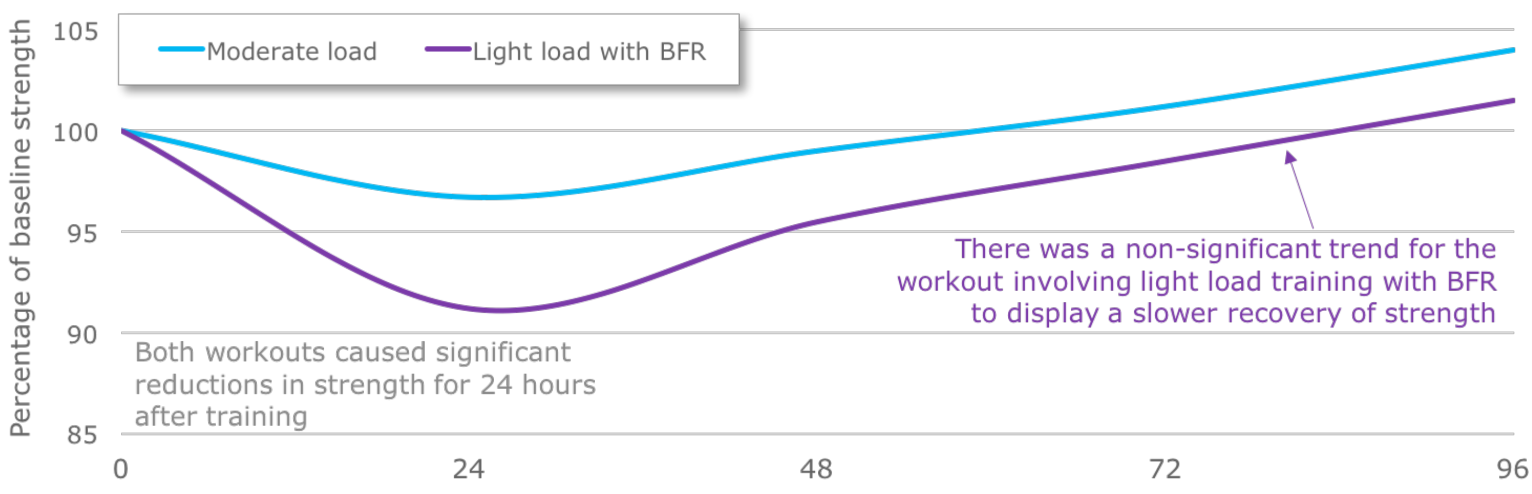


Secondly, the main determinant of muscle damage during strength training is most likely a large influx of calcium ions into the muscle cell (10 – 13), which lead to the release of proteases known as calpains, and not disruptions caused directly by mechanical tension. Thus, we should expect greater muscle damage to occur not when muscle fiber mechanical tension is higher, but when events are triggered that lead to a greater or more sustained influx of calcium ions.

Although active stretch (eccentric training) is effective at causing calcium ion influxes, possibly by several mechanisms (14,15), calcium ions can accumulate inside muscle fibers and cause damage even when the fibers are not stretched actively (10). Indeed, damage has been observed after sustained blood flow restriction (BFR) without exercise, likely for this reason (16).

Normally, workouts involving light loads require longer recovery times than workouts using moderate loads, when the same number of sets are done to failure (17). Given that the dose of mechanical tension is similar in these workouts, it is likely that the greater level of peripheral fatigue involved when using light loads is what causes the greater damage that leads to slower recovery. Peripheral fatigue is caused by several mechanisms, including the release of reactive oxygen species (ROS) (18,19). The presence of ROS is a good marker for muscle damage (20). Thus, ROS may well be the mechanism through which greater peripheral fatigue is linked to damage. It is therefore very interesting that the current study indicates that the use of BFR may have a somewhat ameliorating effect on the muscle-damaging effects of light load strength training to failure, since BFR is known to reduce ROS formation (21).

Maximum **concentric** strength during the 96 hours of recovery from a traditional, moderate load workout and a light load workout with blood flow restriction (BFR), in untrained females



Conclusions

In untrained females, the rate of strength recovery is similar after workouts involving the same number of sets to failure with moderate loads (70% of 1RM) and light loads (20% of 1RM) with blood flow restriction (BFR). This suggests that the two workouts caused similar muscle damage. Even so, light load training with BFR caused more delayed onset muscle soreness (DOMS) than moderate load training.

Practical implications

Using light load strength training with blood flow restriction (BFR) is unlikely to allow faster recovery from a workout, and may in fact cause recovery to occur more slowly. Thus, we should not program a higher training frequency when using light load strength training in conjunction with BFR, compared with normal, moderate load strength training.

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