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Blood flow restriction training: a novel approach to augment clinical rehabilitation: how to do it

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Strength training forms a pivotal part of rehabilitation. Heavy-load strength training (60%–70% one-repetition maximum (1RM)) has been traditionally prescribed to improve muscle strength, body mass and function,[1] but may be unattainable and/or confer increased risk of adverse consequences in individuals with a musculoskeletal (MSK) impairment. The challenge faced by clinical practitioners is how to effectively and safely adapt training loads throughout rehabilitation.

In the past decade, research has proven that blood flow restriction (BFR) during light-load training (eg, 20%–30% 1RM) can produce significant gains in muscle strength and size in healthy populations, in contrast to non-BFR load-matched controls.[2] In this novel training method, limb blood flow is restricted via a cuff throughout the contraction cycle and rest period. This results in partial restriction of arterial inflow to muscle, but, most significantly restricts venous outflow from muscle. Given the light-load nature and strengthening capacity of BFR training, it can provide an effective clinical rehabilitation stimulus without the high levels of joint stress and cardiovascular risk associated with heavy-load training.

CURRENT PRACTICE IN REHABILITATION

The use of BFR in MSK rehabilitation is in its infancy. However, our recent meta-analysis[3] identified studies that included individuals with: knee osteoarthritis (n=3), ligament injuries (n=3), sporadic inclusion body myositis (n=1) and older adults susceptible to sarcopenia (n=13). Light-load BFR training produced greater strength improvements and was more tolerable than light-load training alone in these clinical populations. We are currently using BFR to rehabilitate patients in clinic with various MSK disorders including: patello femoral pain syndrome, meniscal tears, ligamentous strains, low back pain and postsurgical rehabilitation. BFR training is showing promise in terms of reducing pain and improving function, and quality of life.

There are several registered clinical trials under way investigating BFR in rehabilitation from a range of injuries (ACL, wrist fracture, femur fracture and total knee arthroplasty). In addition, within our own groups we are investigating BFR during rehabilitation with patients undergoing haemodialysis, military, patients in intensive care unit, as well as in patients following ACL reconstruction and ankle fractures. Furthermore, there are many examples of the use of BFR for rehabilitation within elite sport, with many practitioners and leading sporting organisations currently applying this technique when rehabilitating their athletes.[4]

EQUIPMENT AND PROTOCOLS USED WITH BFR

With that in mind there is some disparity over the equipment and the way in which individuals use BFR for rehabilitation. Many practitioners are using a range of equipment as well as BFR protocols that do not match usage within published literature.[4] The current approaches that focus on applying BFR during exercise consist of automatic pneumatic tourniquet systems or handheld manual blood pressure cuffs, and more recently elastic wraps, at a range of different pressures and durations, particularly in the emerging rehabilitation literature.

Research demonstrating the influence of thigh circumference and cuff width[5] on occlusion pressure has accentuated a likely need for an individualised approach to BFR, particularly with regard to the setting of the restriction pressure. More recently, a technique to calculate and prescribe the occlusive stimulus as a percentage of total limb occlusion pressure is just one example of efforts to account for the above factors and provide an individualised approach to prescribing BFR training that is relatively quick and inexpensive.

While the relationship between BFR pressure and the underlying tissue compression during exercise is not yet fully understood, BFR training using 40%–80% of limb occlusion pressure is safe and effective when supervised by experienced practitioners[6]; therefore, lower pressures may provide less risk without the need for higher pressure. Establishing limb occlusion pressure is quick and easy to perform with a handheld Doppler and may minimise any cardiovascular risk from the application of BFR during exercise,[7] alongside pre-exercise screening.

RISK OF BFR TRAINING

BFR training has been deemed to incur low risk of many possible adverse responses.[4 8] There have been case study reports of adverse responses to acute sessions of BFR, such as rhabdomyolysis and delayed onset muscle soreness; however, it is likely that these responses are independent of BFR training and simply a response to individuals being unaccustomed to exercise. Therefore, we would currently recommend using 40%–80% of limb occlusion pressure, when conducting BFR training in clinical populations. If increasing strength is the aim of training, and heavy loads cannot be tolerated or are contraindicated, then light-load BFR training is an evidence-based option.

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