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LETTERS TO THE EDITOR

CASE REPORT

Blood flow restriction and blood flow restriction resistance training improves muscle mass, muscle strength and mobility in an older patient with osteoarthrosis carrying the *ACTN3* endurance genotype: A case report

Dear Editor,

Osteoarthrosis is a multifactorial disease of synovial joints commonly seen in older patients, being frequently associated with abnormal mechanical stress or post-trauma conditions. The final result is the occurrence of pain associated with movement in the affected joint, which leads to disuse atrophy, range of motion loss and loss of muscle function.[1] Importantly, rest is contraindicated now and exercise is encouraged.[1] However, high-load resistance training has been frequently contraindicated for these patients, mainly because high loads can aggravate the diseased joint and cause pain.[1] For this reason, low load and high metabolic stress blood flow restriction (BFR) and BFR resistance training (BFRT) methods were tested as a therapy, to increase the muscle mass and muscle strength, in the diseased leg (osteoarthritic knee joint).

A 66-year-old men (weight 71 kg, height 175 cm), ex-professional track and field athlete (400 m hurdles), and former state champion, was submitted to knee surgery on his right knee joint, due to a meniscus tear that was causing pain and limiting his function, and reducing his range of motion. At the time of the injury (early 1980s), according to the patient, physicians suggested that the best option was the complete extraction of the right meniscus. With time, knee osteoarthrosis developed, accompanied by a robust muscle atrophy (and muscle weakness) of the knee extensor muscles. Anterior to posterior X-ray views suggested osteoarthritic changes in the right medial knee, signs of chondromalacia of the right patella and enthesopathy of the right quadricep tendon (not shown). T1 and T2, and fat suppressed short tau inversion recovery magnetic resonance imaging showed loss of articular cartilage in the medial aspect of the knee, grade III

Figure 1 Diseased leg magnetic resonance imaging.

chondromalacia of the right patella, diffuse synovitis of the joint capsule and an old anterior cruciate ligament rupture (Fig. 1).

The BFR intervention was applied twice a week, and the BFRT (leg press, leg extension and leg curl; 3 × 30–15–15 repetitions; 1-min rest between sets and 2 min between exercises) was carried out three times a week, with adherence of 83.3%. For the BFRT, cuff pressure was initially set at 160 mmHg and increased by 20 mmHg after the fifth week (in 20 mmHg), until the completion of the study. After intervention (8 weeks), the anterior thigh muscles (rectus femoris and vastus intermedius muscles) of the diseased leg presented large increases in muscle thickness (30.2%), evaluated through ultrasound imaging. In terms of magnitude, this is in contrast with the recently published study by Ferraz *et al.*, which investigated the effects of BFRT over 12 weeks on clinical outcomes.[2] In that study, researchers observed increases of 7% in the quadriceps muscle cross-sectional area, evaluated through magnetic resonance imaging. Although different muscles were evaluated using different techniques, in the present study, a far superior increase in muscle thickness was observed. One of the reasons for that might be the synergistic effects of BFR + BFRT in the present study, versus BFRT in the aforementioned study. Another potential explanation for the enhanced muscle hypertrophy observed in the present study might be related to the high protein consumption of the patient, which was intentionally increased from 1.4 to 1.8 g/kg/bodyweight, in order to reinforce muscle protein accretion. The patient presented normal testosterone levels for his age, (608 ng/dL pre- to 484.30 ng/dL post-intervention), which would be permissive to the increased hypertrophy response. Finally, the patient was an ex-state champion of 400-m hurdles, a modality that involves a great amount of metabolic stress. As a way to investigate a possible relationship with BFR + BFRT responsiveness, *ACTN3* genotyping analysis was carried out. The *ACTN3* RR and RX genotypes have been associated with high speed and strength in athletes, and the XX genotype has been associated with aerobic endurance.[3,4] Interestingly, the patient presented the endurance type genotype (XX). As endurance athletes present increased resistance to fatigue, it is possible that the high muscle hypertrophy phenotype herein observed was the summation of the *ACTN3* endurance genotype, plus the BFRT. In fact, markers of muscle performance (1 RM, total weight lifted and performance tests) were all robustly increased (not shown), thus contributing to the high muscle hypertrophy observed. No signs of acute pain, swelling or inflammation in the diseased knee joint were observed in this patient.

In regard to the mechanisms of action, it has been suggested that BFR and BFRT are capable of sparing or increasing the muscle mass through increased muscle cell swelling, increased β2-adrenoceptor signaling, increased recruitment of higher threshold fibers and activation of anabolic cell signaling pathways.[5] However, such mechanisms were not evaluated in the present study.

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