Objective Functional Assessment, Lean Mass Analysis And Associated Genetic Adaptations Of The Operated Leg Following Total Hip Arthroplasty

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Introduction: Significant muscle wasting occurs prior to and persists after total hip arthroplasty (THA), with strength deficits in the affected leg of 10-21% (1). This study aimed to characterize the possible metabolic pathways for early muscle recovery following THA by combining associated genetic adaptations in the affected leg with objective functional measures and body composition analysis.

Methods: Following ethical approval and informed consent, 14 patients (males n=8, aged (mean ± SD) 64.6± 9.1 yrs; females n=6 aged 61± 12.2 yrs) were recruited. Objective function was assessed with 3 measures: maximal voluntary contraction of the operated leg quadriceps (MVCOLQ) in newtons (N), chair sit to stand (ST) score in 30 seconds, and the six minute walk test (6MW T) in metres (m). Lean mass (grams, g) of the operated leg was assessed by dual energy X-ray absorptiometry (DEXA) scanning. Genetic adaptations were assessed with vastus lateralis (VL) muscle biopsies (taken ~5cm proximal to the suprapatellar pouch). Real time quantitative polymerase chain reaction (RT-qPCR) analysis was performed on the biopsies for genes coding for hypertrophy (FOS, calpain2 (CAPN2)), atrophy (20s proteasome alpha subunit 7 (PSMA7), cathepsin L2 (CTSL2), inflammation (TNF, IL-6) and lipid metabolism (lipoprotein lipase (LPL), and peroxisome proliferated activated receptor gamma (PPARAG). All the above measurements were performed preoperatively and 6 weeks postoperatively. Paired t-tests were used to assess improvements in the objective measures and lean mass, with Benjamini-hochberg corrections applied to the multiple analyses for the RT-qPCR analysis. P<0.05 was considered statistically significant.

Results: At 6 weeks post-THA, there were no significant differences, relative to preoperative values, in any of the objective function measures or in leg lean mass (MVCOLQ (mean ± SD, pre-op vs. 6 weeks post-op) 186.9 ± 77.8N vs. 201.4 ± 60.2N, p=0.438; ST 10.1 ± 3.8 vs. 11.4 ± 5.18, p=0.122; 6MW 251.6 ± 124.8m vs. 264.5 ± 109.0m, p=0.497; and lean mass 6329.8 ± 8793.9g vs. 6835.1 ± 8857.4g, p=0.777). Compared to baseline, markers for hypertrophy were increased at 6 weeks (FOS +1463%, p=0.016; with CAPN2 trending towards a significant increase +129.2%, p=0.087. Atrophy markers were reduced at the same time point (PSMA7 -44.8%, p=0.016; CTSL2 -42.5%, p=0.050), with inflammation (TNF -29.6%, p=0.023) and lipid metabolism showing the same trend (LPL -42.45%, p=0.016). Despite declines of 82.7 % and 26.3 % in the expression levels of IL-6 and PPARAG, significance was not attained.

Discussion: Significant increases for genetic markers of hypertrophy indicating a hypertrophic cellular muscle response are apparent in VL muscle in the short term following THA. These increases are not reflected in either function or leg lean mass. Rehabilitation regimes that feature an exercise intensity that is sufficient to induce increments in objective function measures and lean mass may be capitalizing on a post-THA intramuscular cellular environment supportive of anabolism.

Significance: An anabolic cellular response in muscle following total hip arthroplasty is potentially beneficial in helping maximising functional gain from the procedure.

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