Is Gluteal Fatty Infiltration on MARS MRI associated with poor Outcomes in THA Patients with Adverse Local Tissue Reactions?

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INTRODUCTION: Gluteal muscle atrophy has been reported to be very common in patients with failing hip replacements due to adverse local tissue reactions (ALTR). ALTR has been well described as a complication of metal-on-metal (MoM) total hip arthroplasty (THA), with ALTR being described as a complication caused by biological response to metal debris particles. Although previous studies investigated functional and clinical outcomes with gluteal atrophy, there is no study to date investigating the correlation of gluteal fatty infiltration with patient outcomes. This is despite the fact that fatty infiltration into the gluteal muscles may potentially have the same adverse effect on patient outcomes that the volumetric shrinkage of gluteal muscles has. The aim of this study is to analyze the effect of gluteal fatty infiltration and muscle atrophy on patient outcomes including complication and re-operation rates in THA patients with adverse local tissue reactions.

METHODS: 82 patients (35 males and 47 females; mean age: 62±10.64 (range: 39-70) with unilateral failing hip replacement due to adverse local tissue reactions were retrospectively evaluated. MARS MRI Magnetic resonance images of all patients were evaluated at 38 months of follow-up. The gluteus minimus, medius and maximus and were segmented on a slice-by-slice basis and reconstructed to 3D volumes. Quantitative estimates of the proportion of intramuscular fat based on MR signal intensities were determined to assess gluteal fatty muscular infiltration. Patient records were reviewed for demographics and clinical outcomes, including blood metal ion levels, re-revision and complication rates. Statistical analysis was performed using Spearman correlation.

RESULTS: Mean fat content of the gluteus minimus, medius and maximus as measured by quantification of signal intensity profiles was 42.4% ± 23.9%, 34.7% ± 19.1% and 15.5% ± 4.0%. There was no significant correlation between pre-operative cobalt and chromium levels with fatty infiltration for gluteus minimus (p=0.34; p=0.21), gluteus medius (p=0.46; p=0.39) and gluteus maximus (p=0.52; p=0.6; Figure 1). There was no significant correlation between post-operative dislocation and recurrent ALTR with fatty infiltration of gluteus minimus (p=0.67; p=0.56), gluteus medius (p=0.31; p=0.58) and gluteus maximus (p=0.48; p=0.72). There was no significant correlation between re-revision rates and fatty infiltration of gluteus minimus (p=0.63), gluteus medius (p=0.44) and gluteus maximus (p=0.82). With regards to gluteal muscle atrophy, there was no correlation between pre-operative cobalt and chromium levels and muscle atrophy for gluteus minimus (p=0.16; p=0.23), gluteus medius (p=0.30; p=0.37) and gluteus maximus (p=0.61; p=0.54). However, there was a strong correlation between gluteus minimus and medius atrophy and dislocation (p=0.09; p=0.04) as well as re-revision rates (p=0.11; p=0.06).
The presence of severe gluteal atrophy for gluteus minimus and medius was correlated with tensor fasciae latae hypertrophy ((p=0.02). Tensor fasciae latae hypertrophy was noted in 14/82 patients. Patients with tensor fasciae latae hypertrophy had an increase in muscle volume of 15±9.3%. The increase in muscle volume was accompanied by a significantly larger presence of intramuscular fat deposition (28±15.1% vs 16±9.8%, p=0.01). There was no significant difference between both cohorts with respect to post-operative dislocation (p=0.61), recurrence ALTR (p=0.47) and re-revision rates (p=0.35).

DISCUSSION: This is one of the first studies to investigate the effect of gluteal fatty infiltration on patient outcomes, demonstrating that fatty infiltration of either gluteus minimus, gluteus medius or gluteus maximus is not associated with post-operative clinical patient outcomes. Therefore, fatty gluteal infiltration may be less significant on patient outcomes than gluteal atrophy, which has been demonstrated to correlate with inferior clinical outcomes with regards to dislocation and re-revision rates. The compensatory hypertrophy of the tensor fasciae latae has been found to be due to increased intramuscular fatty infiltration, suggesting that there is no biomechanical compensation for gluteal atrophy due to hypertrophy of the tensor fasciae latae in THA patients with adverse local tissue reactions.

SIGNIFICANCE/CLINICAL RELEVANCE: This study demonstrates that fatty infiltration of the gluteal muscles is not correlated with post-operative clinical patient outcomes, suggesting that fatty gluteal infiltration may be less significant for patient outcomes than gluteal atrophy, which has been demonstrated to correlate with increased dislocation and re-revision rates.

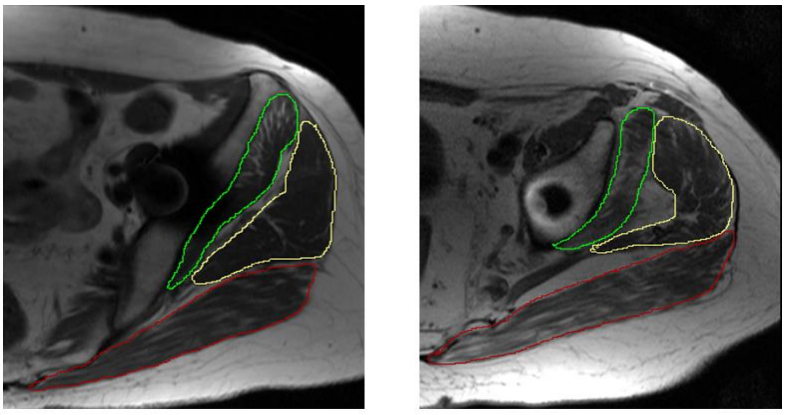

Figure 1: Minimal gluteal fatty infiltration for gluteus medius (yellow), minimus (green) and maximus (red) (on the left) compared to moderate gluteal fatty infiltration for gluteus medius, minimus and maximus (on the right), with increasing amounts of gluteal fatty infiltration being not a predictor for worse outcomes.