**IN VIVO GLUTEUS MEDIUS VOLUME AND SHAPE VARIATIONS ACROSS GENDER AND DISEASE STATUS**

Markus O. Heller (1), Alexander Wurl (1), Carsten Perka (2), Hans-Christian Hege (3)

1. Julius Wolff Institute, Charité Berlin, Germany; 2. Centre for Musculoskeletal Surgery, Charité Berlin, Germany; 3. Zuse Institute Berlin, Germany

**Introduction**

The gluteus medius (GM) plays a critical role for joint function and stability after total hip replacement (THR). Whilst gender differences in the bony anatomy of the hip are well established, disease and gender dependent variations of the GM muscle are not understood in detail. However, objective characterization of the GM muscles could provide essential information for the planning of THR procedures, especially in revisions where the restoration of a stable joint is particularly dependent upon the condition of the muscles. Previous research in young healthy subjects has shown that the volume of shank muscles can be estimated from a reduced set of measurements that include the max. anatomical cross-sectional area (ACSA) and muscle length [Albracht et al. 2008]. If similar relationships would hold true for the GM, quantitative assessment of its status could be realized with reduced effort, facilitating objective characterization of the active stabilizers of the joint in the planning of THR procedures. This study therefore aimed to quantify GM volume in THR patients in order to assess whether disease and gender differences in the GM volume existed, and to evaluate whether a simplified quantification of GM volume was possible.

**Materials and Methods**

The study included 44 patients with unilateral THR (22 male, mean age 68y). CT scans were used to define a bony pelvic reference system and for segmentation of the GM on the operated and native, contra-lateral hips to derive the length and volume, but also the max. ACSA of the GM. GM shape was characterized by the ratio of volume to max. ACSA times muscle length. The predictive power of a shape based approximation of GM volume was assessed by calculating the RMS. T-tests compared GM volume and shape between male and female patients, THR and contra-lateral hips.

**Results**

While GM volume was generally lager in man than in women (361.1 vs. 264.8 cm³, p<0.001), GM shape did not differ between gender (Fig. 1). Across all patients, GM volume was smaller on the THR than the native joint, but the general GM shape was unaltered. When mean shape, max. CSA and muscle length were combined, GM volume could be predicted with an RMS of 5%.

![Figure 1: GM ACSA distribution plotted over pelvic height for both male and female THR patients.](image)

**Discussion**

This study in a lager cohort of THR subjects found that not only gender, but also disease status influenced overall GM muscle volume. However, the general shape of the GM was found to be preserved across gender and disease, a finding that could be exploited in future, automated procedures for determining muscle volume from CT. We could demonstrate that an accurate estimation of GM muscle volume was possible from understanding its general shape and measuring its max. ACSA and length. Maximum ACSA was typically found close to the easily identifiable anterior superior iliac spines (Fig. 1), a discovery that facilitates the determination of the max. ACSA in clinical routine. Measurement of only two parameters thus provides an effective way to quantify muscle volume, especially in patients undergoing revision THA, and could identify subjects who would benefit most from soft tissue sparing approaches or require further procedures to stabilize the hip.

In conclusion, this study provides evidence that GM shape is preserved across gender and disease state and identifies a procedure by which accurate estimation of GM volume in THR patients can be achieved. Access to a reliable measure of muscles status in the planning of THR might be critical for restoring joint function and stability also under the challenging conditions often found in revision THR.

**References**