Opportunistic Use of Computed Tomography to Determine Muscle-Adipose Ratio Reliably Predicts Wound Complications after Kocher-Langenbeck Surgical Exposure of the Acetabulum

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INTRODUCTION:

A unique factor related to acetabular fractures is the preoperative and, in many cases, the postoperative computed tomography (CT) scan that is obtained to understand fracture nuances. While this imaging study is routinely obtained, there are limited studies reporting its use as an opportunistic modality to understand body composition to predict the potential for postoperative wound healing complications. Waist-to-hip ratio (WHR) has been reported as a method to assess central obesity but does not specifically address the surgical site. As such, we aim to utilize the postoperative CT scan to define the muscle-to-adipose ratio (MAR) at the level of the acetabular dome.

Our aim is to determine whether the MAR along the course of a Kocher-Langenbeck incision is more accurate at predicting postoperative wound complications following acetabular fixation than WHR or BMI. Our hypothesis is that a lower MAR will be a more accurate measure than BMI or WHR at predicting the potential for postoperative wound complications.

METHODS:

All patients between 17 and 64 years-of-age who sustained a closed, displaced posterior wall acetabular fracture and underwent surgical treatment through a Kocher-Langenbeck approach over a 3-year period were identified. For inclusion, patients had to have a fine-cut (3 mm) preoperative CT scan of the pelvis, a postoperative CT of the pelvis, and a minimum follow up of 12 months.

A chart review was completed from which demographic data was collected. Data points recorded included age, mechanism of injury, medical comorbidities, tobacco use, length of the procedure, and duration of follow up. The primary outcome was the presence of a surgical site infection. A superficial infection was defined as any wound with cellulitis requiring antibiotics or requiring surgical debridement to the fascia. Wound healing complications were also considered superficial in the setting of dehiscence or prolonged drainage. An infection was defined as deep when surgical debridement extended deep to the fascia.

WHR was calculated utilizing our institutional picture archiving and communication system. The postoperative CT was used to calculate the MAR as it had a staple line defining the surgical incision. The MAR was obtained on the axial CT at the level of the acetabular dome. A horizontal line was drawn from the acetabulum to the outer edge of the gluteus maximus to define muscle depth. Similarly, a horizontal line from the outer edge of the gluteus maximus to the skin defined adipose depth (Figure 1). The integrated PACs measuring tool was utilized to complete each measurement. Interobserver agreement for WHR and MAR was determined by calculating the intraclass coefficient from results obtained from two observers (attending surgeon and resident) blinded to the clinical outcome (presence of infection) after reviewing the measurement methodology.

RESULTS:

One-hundred-ninety-three patients met inclusion criteria. The mean age was 41 years (range 18 – 62) and 129 (66.8%) were male. The mean length of follow up was 17.4 months (range 12 – 26). Thirty (15.5%) patients developed a wound complication of which 17 (8.8%) were superficial and 13 (6.7%) were deep (Table 1).

There were no significant relationships between patients with regard to age, smoking status, surgeon performing the procedure, or presence of comorbidities including diabetes mellitus, congestive heart failure, coronary artery disease, rheumatoid arthritis, or hypothyroidism.

The mean BMI for the patients who developed a wound complication was 35.9 (SD = 9.0) versus 28.1 (SD = 5.7) for those who did not develop a wound complication ($p = 0.002$). The mean WHR was 0.87 for both groups of patients who developed or did not develop a wound complication ($p = 1.00$). The mean MAR was 0.67 (SD = .10) for patients with a wound complication versus 0.75 (SD = .08) for those without complication ($p = 0.007$).

Two separate binary logistic regression models were developed to assess the relationship between the predictor variables (BMI and MAR) while controlling for gender and hypertension. The first model was significant and showed that BMI is significant predictor of infection while controlling for gender and hypertension ($p < .001$). The second model was also significant indicating that MAR is a significant predictor of infection while controlling for gender and hypertension ($p = .013$). Additionally, ROC curves were constructed to determine the predictive ability of BMI, WHR, and MAR for infection. The ROC analysis demonstrated an area under curve (AUC) for BMI to be .717 (95% CI, .577-.857, $p = .006$) and for MAR to be .680 (inverted, 95% CI .507-.854, $p = .022$), whereas the AUC for WHR was not significant, indicating poor discriminative ability (Figure 2).

The comparison of CT-based measurements (WHR and MAR) demonstrated an intraclass correlation coefficient of 0.99.

DISCUSSION AND CONCLUSION: Overall, we found that MAR is a significant predictor of postoperative wound complication in obese patients undergoing treatment of posterior wall acetabular fractures. The higher rate of wound complications in patients with a low MAR should be considered in the treatment of these patients and may be used to guide discussion regarding the risks of surgery, as well as the potential use of adjuncts to reduce wound healing complications.

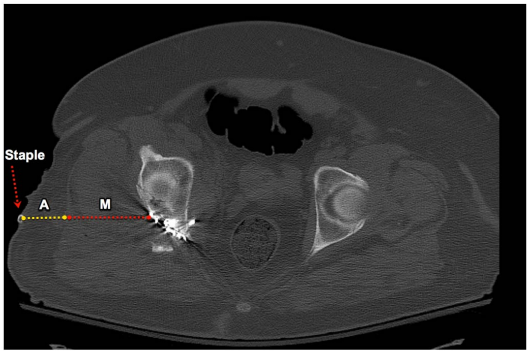

Figure 1:

Axial CT demonstrating the MAR. Muscle depth= red dotted line (M) from the acetabulum to outer edge of the gluteus maximus. Adipose depth= yellow dotted line (A) from the outer edge of the gluteus maximus to the skin.

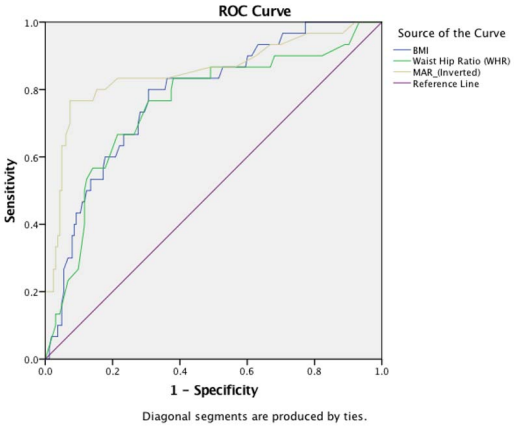

Figure 2:

ROC Curve for Any Infection (Superficial or Deep) based on Traditional Weight Measures