The Journal of Arthroplasty 31 (2016) 1788–1791

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Complications - Infection

Subcutaneous Fat Thickness Is Associated With Early Reoperation and Infection After Total Knee Arthroplasty in Morbidly Obese Patients

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ARTICLE INFO

Article history:
Received 7 October 2015
Received in revised form
28 December 2015
Accepted 1 February 2016
Available online 8 February 2016

Level of Evidence:
Level III
prognostic study

Keywords:
morbid obesity
subcutaneous fat
body mass index
total knee arthroplasty
wound complication

ABSTRACT

Background: Morbid obesity has been associated with increased complications after primary total knee arthroplasty (TKA), but previous studies have failed to take factors such as body composition and fat distribution into consideration. The aims of this study were to (1) assess the interobservable and intraobservable reliabilities of measuring anterior knee subcutaneous fat thickness on lateral knee radiographs and (2) determine if these measurements associate with early complications in patients with morbid obesity.

Methods: Using a retrospective case-control analysis, we reviewed 1689 primary TKAs performed in morbidly obese patients at our institution from 1995 to 2012. All patients (n = 58) who required reoperation for wound complication or infection within 90 days were compared to a matched cohort of morbidly obese patients who did not require early reoperation. Distances from patella skin (prepatellar thickness) and tibial tubercle skin (pretubercular thickness) were measured on routine lateral knee radiographs and associated with outcomes.

Results: Intraobserver and interobserver reliabilities were excellent for both measurements. Knees in the reoperation group had significantly greater prepatellar ($P = .0001$) and pretubercular ($P = .0006$) soft tissue thickness. Prepatellar thickness ≥15 mm and pretubercular thickness ≥25 mm increased the risk of early reoperation by 2.0× ($P = .0003$) and 1.6× ($P = .023$), respectively, and were more predictive measurements than body mass index.

Conclusion: Anterior knee subcutaneous fat thickness can be reproducibly measured on lateral knee radiographs and is associated with a significantly increased risk of early reoperation for wound complications and infection after primary TKA in morbidly obese patients.

Obesity continues to be an area of concern among arthroplasty surgeons. Obese patients have been shown to present with surgical knee arthritis at a younger age [1]. Unfortunately, both early and late complications have been associated with total knee arthroplasty (TKA) in these patients [2-7]. In an attempt to identify those at highest risk, many studies have associated complication with body mass index (BMI), with morbid obesity (BMI ≥40 kg/m^2) being a group of particular interest [1-7].

BMI is a readily accessible and simple tool for clinicians to use. Furthermore, it is easily calculated and generally available for the purposes of retrospective studies. However, because BMI does not take body composition, fat distribution, or associated comorbidities into consideration, it is generally acknowledged to be a nonspecific variable [8]. Alternative measures of body composition, such as percent body fat, have been shown to correlate more closely with outcomes than BMI [9]. However, such testing often requires specialized testing equipment which is not readily available or practical for typical clinical practice.

Peri-incisional subcutaneous fat thickness, directly measured from preoperative imaging, has previously been correlated with postoperative complications after cardiac and cervical spine surgery [10-12]. It is conceivable that similar measurements could be applied to patients undergoing TKA. The aims of this study were to

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.02.008.

Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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http://dx.doi.org/10.1016/j.arth.2016.02.008
0883-5403/

(1) assess the interobservable and intraobservable reliabilities of measuring anterior knee subcutaneous fat thickness on routine lateral knee radiographs and (2) determine if these measurements associate with early complications in patients with morbid obesity.

Methods

Study Design

After obtaining approval from our institutional review board, we conducted a retrospective matched case-control analysis. We used our institution's total joint registry to identify all (n = 1689) primary TKAs performed in patients with morbid obesity at our institution over a 17-year period (1995-2012). All patients who required reoperation for wound complication or infection within 90 days of surgery were identified (reoperation group) and compared to a matched cohort of morbidly obese patients who did not require early reoperation (comparison group). A 1:1 match was performed using the following as criteria: gender, age (±3 years), date of surgery (±1 years), BMI (±1 kg/m^2), and diagnosis of diabetes mellitus. Medical records were examined for details regarding complications and reoperations. Reoperation was defined as any unplanned return to the operating room because of wound complication or infection. Periprosthetic joint infections were defined using Musculoskeletal Infection Society criteria [13].

Patients

Each group consisted of 58 patients, including 40 (69%) females and 40 (69%) patients with type II diabetes mellitus. Mean age and BMI were 63 years (range, 39-80 years) and 45 kg/m^2 (range, 40-58 kg/m^2) in each group, respectively (Table 1). Mean follow-up was 5 years in each group (range, 6 months-11 years). Reoperations included 25 wound revisions (including 3 flaps), 5 hematoma evacuations, 18 irrigation and debridements with polyethelene exchange for periprosthetic joint infection, and 10 2-stage revisions for periprosthetic joint infection.

Radiographic Measurement

Two separate unique measurements were evaluated. The prepatellar thickness (PPT) was determined by measuring the distance between the midpatella and the skin, with the measurement being made perpendicular to the anterior patellar cortex (Fig. 1). Similarly, the pretubercular thickness (PTT) was determined by measuring the distance between the most prominent aspect of the tibial tubercle and the skin, with the measurement being made perpendicular to the anterior cortex of the tibial tubercle (Fig. 1). All measurements were made on standardized digital preoperative lateral knee radiographs and using 100-mm markers to adjust for magnification. Lateral knee radiographs were obtained with patient's supine and knees flexed to 30°. All measurements were made twice by 2 authors (for a total of 4 times per measure) in blinded fashion to allow for evaluation of intraobserver and interobserver reliabilities.

Table 1
Demographics.

Variable	Reoperation Group	Comparison Group	*P* Value
Patients	58	58	
Age (y)	62.7 ± 9	63.0 ± 8	.83
Female gender	40 (69%)	40 (69%)	1.0
Diabetes mellitus	40 (69%)	40 (69%)	1.0
BMI (kg/m^2)	44.8 ± 4	44.9 ± 4	.89
Follow-up (y)	5.3 ± 3	5.2 ± 3	.87

BMI, body mass index.

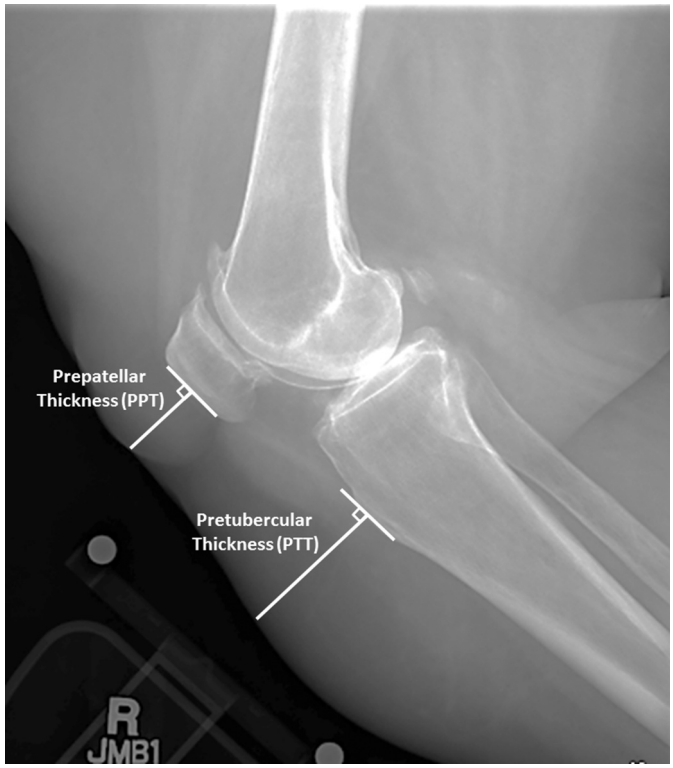

Fig. 1. The prepatellar thickness was determined by measuring the distance between the midpatella and the skin, with the measurement being made perpendicular to the anterior patellar cortex. The pretubercular thickness was determined by measuring the distance between the most prominent aspect of the tibial tubercle and the skin, with the measurement being made perpendicular to the anterior cortex of the tibial tubercle.

Statistical Analysis

All outcomes were analyzed using appropriate summary statistics. Baseline covariates were compared using chi-square tests or logistic regression (for categorical outcomes), or 2-sample tests or Wilcoxon rank sum tests (for outcomes measured on a continuous scale) as applicable. Inter-rater and intrarater reliabilities were assessed for each radiographic parameter using Pearson coefficients. Furthermore, internal reliability was assessed using Cronbach alpha coefficients. Risk ratios were calculated using arbitrary cutoffs of ≥15 mm for PPT and ≥25 mm for PTT. All statistical tests were 2-sided, and the threshold of statistical significance was set at $\alpha = 0.05$.

Results

Both PPT and PTT were successfully measured with excellent intrarater and inter-rater reliabilities. Pearson coefficients for intrarater reliability were 0.95 for PPT and 0.98 for PTT. Similarly, Pearson's coefficients for inter-rater reliability were 0.92 for PPT and 0.96 for PTT. Cronbach alpha coefficients were 0.97 for PPT and 0.99 for PTT, indicating excellent internal reliability.

Prepatellar and PTT were both significantly increased in patients who required early reoperation. PPT was 16.9 mm (range, 4-49 mm) in the reoperation group vs 10.3 mm (range, 3-31 mm) in the comparison group ($P = .0001$). Similarly, PTT was 24.6 mm (range, 7-85 mm) in the reoperation group vs 16.4 mm (range, 3-83 mm) in