Management of Femur Shaft Fractures in Obese Patients

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KEYWORDS

• Femur fracture • Obesity • Intramedullary nailing • Outcomes

Given the ongoing epidemic of obesity, femoral fracture management in the population affected by this condition is likely to become more frequent. Obesity in the United States has been steadily increasing over the last few decades, rising from 13.3% in 1960 to 31% in 2002.[1] Similarly, the prevalence of obesity has dramatically increased among children from 10 to 17 years from 6% in 2003 to 16% in 2007. Also, obesity increased by up to 33% among Hispanic children and children from single-parent households,[2] with rates reported as high as 40%.[3,4] Extreme obesity (body mass index [BMI] >40 kg/m^2) has further increased from 2.9% from 1988 to 1994 to 4.7% from 1999 to 2000,[5] and was reported to be 5.7% from 2007 to 2008 with an especially high prevalence in non-Hispanic black women (14.2%).[6]

Fracture treatment in obese patients poses a special challenge, given the greater difficulty in establishing an accurate diagnosis and confirming associated injuries. Adequate intraoperative positioning and obtaining accurate reduction and stable fixation may require special considerations. Obese patients have a high predisposition for complications such as compartment syndrome, nerve injuries, and pressure ulcers, and are at increased risk for medical complications given the high prevalence of comorbidities.[7–11] A thorough understanding of the risks associated with obesity and the diagnostic and therapeutic challenges involved with femoral shaft fractures in this setting is paramount to achieve adequate results.

THE OBESE PATIENT

Obese patients have lower self-reported health-related quality of life[12] as well as an increased risk of having coronary artery disease, type 2 diabetes mellitus, and endometrial, breast, colon cancer, hypertension, dyslipidemia, stroke, gallbladder disease, osteoarthritis, sleep apnea, and respiratory problems.[8] As a consequence, obese patients carry an increased risk for systemic complications including infection, deep venous thrombosis, myocardial infarction, and pneumonia.[10,11,13,14] Maheshwari and colleagues[9] studied the effect of obesity on the morbidity of patients who suffered femur or tibia fractures during a motor vehicle collision. In a cohort of 665 patients, obese subjects had a higher prevalence of reported baseline cardiac disease and diabetes compared with non-obese patients. Furthermore, obese patients had more severe fracture patterns involving the distal femur (90% vs 61%, $P<.01$). No differences were found in postoperative complications, but obese patients had an almost 2-fold mortality risk that approached statistical significance (9.5% vs 5.6%, $P = .07$). Other studies on critically injured blunt trauma patients have confirmed obesity as an independent risk factor for mortality, increased hospital and intensive care unit length of stay, and prolonged use of mechanical ventilation in

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survivors.[15–17] Regarding nosocomial infections, Choban and colleagues[14] compared a cohort of 849 patients undergoing general, urologic, vascular, thoracic, or gynecologic surgical procedures and found an increased incidence in patients with higher BMI. Although infections occurred in 0.5% of patients with BMI of less than 27 kg/m^2, frequencies increased to 2.8% in patients with BMI of 27 to 31 kg/m^2 and 4.3% in patients with BMI greater than 31 kg/m^2. Wound healing problems have additionally been found to be more frequent in obese patients undergoing acetabular and femoral fracture fixation, with diabetes and the presence of extensive panniculus contributing to the occurrence of this complication.[11,13]

INCIDENCE AND MECHANISM OF INJURY

Despite femoral shaft fractures having been a subject of extensive research, only limited literature has focused on the management of these fractures in the obese population. According to Tucker and colleagues,[18] 20% of patients with femur fractures are obese (BMI $\geq$30 kg/m^2), with an obesity rate among women of 32% compared with 15% in men. Motor vehicle accidents account for about 50% of femoral shaft fractures. This proportion is similar between obese and nonobese individuals. Sports and motorcycle accidents account for a substantial proportion of fractures in nonobese patients but not in obese patients, presumably because the latter are less frequently engaged in these activities. Falls, however, account for 31% of femur fractures in obese patients compared with only 14% in nonobese individuals.[18] Furthermore, it is not infrequent in obese individuals for fractures to occur unrelated to or after only a minimal traumatic event. Although the absence of significant trauma may lead to the perception of the fracture having been caused by low energy, the opposite is, however, most likely the case. Contrary to nonobese patients in whom low-velocity fractures are likely to be related to decreased bone mineral density, in obese individuals they occur in the presence of increased bone mineral density and bone cross-section area.[19] Owing to a large body mass, even at low trauma velocities, significant energy can be generated leading to significant fracture comminution and soft-tissue damage.[9]

DIAGNOSIS

Heightened suspicion for a femoral fracture should be present in the obese patient with marked thigh pain after even minor trauma. Given the large body habitus, fractures of the femur may not be readily apparent in the patient population. Concomitant injuries to ipsilateral and contralateral acetabulum, pelvis, hip, and knee should be actively ruled out during the secondary survey, as the probability of these going unnoticed is increased in the patient population.[20] Dedicated views for the hip and knee as well as trauma series for pelvis and acetabulum should be taken. In the general population up to 9% of femoral shaft fractures have an associated femoral neck fracture, of which up to 50% are missed at initial assessment (**Fig. 1**).[21–23] Although no specific data have been published for obese patients, this population is at increased risk for missed diagnosis owing to poor visualization of the femoral neck given the presence of large amounts of adipose tissue. Although active screening for these fractures on femur radiographs as well as specific internal rotation hip views should be performed, computed tomography scans of the proximal femur may be indicated in this patient population.[21,23,24] In a cohort of 152 femoral shaft fractures, Yang and colleagues[23] found 12 femoral neck fractures at the moment of admission. Of these, a total of 6 nondisplaced fractures were not detectable using conventional radiography but could be observed on computed tomography (CT) scans. Tornetta and colleagues[21] showed that fine-cut (2 mm) CT scanning of the proximal femur was able to detect 12 of 13 (92%) femoral neck fractures associated with fractures of the ipsilateral femoral shaft, as opposed to only 8 (62%) fractures using only hip radiographs. Furthermore, with CT scanning the incidence of delayed diagnosis could be reduced from 57% to 6%, allowing for earlier femoral neck fracture recognition and management. CT scanning is of additional use for the postoperative assessment of the acetabulum and femoral neck after closed reduction of associated ipsilateral hip dislocations (**Fig. 2**).

Obese patients are at higher risk of having comminuted fractures. According to Tucker and colleagues,[18] whereas nonobese patients had comminuted (Orthopedic Trauma Association type C) fractures in 18% of cases, obese patients had comminution in 25% of cases. Open fractures occurred with equal frequency in obese and nonobese patients in 17% and 16% of cases, respectively. However, no type III open fractures were found in obese patients, whereas they accounted for 35% of open fractures in nonobese patients. This finding may suggest that femur fractures in obese patients rarely lead to inadequate soft-tissue coverage; however, open fractures in this patient population should suggest an even higher level of energy, as expected for this type of fracture in nonobese subjects. Furthermore, a high