

Research Article

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Weight Changes after Ankle Fracture Surgery: A Retrospective Cohort Study

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Keywords

Obesity
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Abstract

Background: Recovery from open reduction internal fixation of the ankle frequently involves a decrease in activity level and some limitations in weightbearing. The purpose of this study was to evaluate weight changes during the postoperative period following ankle fracture surgery.

Methods: Hospital billing records were retrospectively reviewed to identify all patients who underwent open reduction internal fixation of bimalleolar and trimalleolar ankle fractures at our hospital system between January 1, 2018 and June 30, 2021. Weight data from outpatient encounters coinciding with the 3-month, 6-month, and 1-year postoperative time points were recorded and analyzed.

Results: 56 patients had complete weight data. The mean age at surgery was 44.6±16.2 years. There were 27 women and 29 men. At time of surgery, the mean weight was 197.2±53.9 lbs and BMI was 30.3±7.1 kg/m². At 1 year postoperative, the mean weight was 219.2±51.6 lbs and BMI was 33.8±7.0 kg/m², representing statistically significant increases of 22.0 lbs and 3.4 BMI points compared to preoperative (p=0.0491 and 0.0330, respectively). On subgroup analysis of different preoperative BMI groups (<25, 25-29, 30-34, and ≥35), only those patients with a pre-operative BMI of <25 experienced statistically significant increases in weight and BMI, 27.9 lbs and 4.8 kg/m² respectively (p=0.029 and p=0.001).

Conclusion: This is the first study to evaluate weight changes following ankle fracture. This study showed that at 1 year patients recovering from ankle open reduction internal fixation gain an average of 22 lbs and 3.4 BMI points. Patients with a pre-operative BMI of <25 are subject to statistically significant increases in weight. We recommend monitoring patients' weight and counseling them on the risks of weight gain. Further research is necessary to better characterize the risk of weight gain following orthopedic surgery.

Level of Evidence: 4 (retrospective cohort)

Introduction

Patients with operative ankle fractures often have some weight-bearing restrictions and experience significant changes in their activity level¹. While maintaining weightbearing restrictions, patients are likely less active than those with no mobility restrictions and could thus be subject to alterations in their weight².

Obesity is a global health pandemic with significant economic and health consequences³⁻⁵. Compared to patients with a healthy body mass index (BMI 18.5-25), patients with a BMI in the overweight (BMI 25-30) and obese (BMI >30) categories have more comorbidities and are at much greater risk for health-related complications⁶⁻⁸. Despite

the increasing prevalence of obesity in the United States (US), few studies have evaluated weight changes following orthopedic surgery. For example, only a handful of studies have been published in the orthopedic arthroplasty literature attempting to characterize weight changes in patients recovering from total hip and knee arthroplasty, but authors have found differing results⁹⁻¹¹. A systematic review on the topic identified 8 articles evaluating weight changes following total joint replacement and weakly concluded that weight gain appears to be more common than weight loss¹². However, similar studies have not been published in the orthopedic trauma or foot and ankle literature. Additionally, the arthroplasty literature is likely not generalizable to the orthopedic trauma population due to the non-elective nature of trauma, less preoperative medical optimization and prescribed weight loss, presence of comorbidities and other surgical risk factors, different postoperative weightbearing restrictions, lack of pre-established physical therapy regimens, and others. Thus, there is a paucity of research detailing how recovery from orthopedic trauma affects weight in the postoperative period.

Ankle fractures are a common injury, with an incidence rate of 4.22/10,000 person-years¹³. Patients sustaining ankle fractures represent an ideal population to study the effects of weightbearing restrictions and the ensuing period of inactivity and decreased energy expenditure. The purpose of this study was to evaluate postoperative weight changes in patients recovering from ankle fracture surgery.

Methods

This was a retrospective study. Hospital billing records and CPT codes were used to identify all adult patients who underwent open reduction internal fixation of bimalleolar and trimalleolar ankle fractures at our hospital system (consisting of a Level 1 Trauma Center and Level 3 community hospital) between January 1, 2018 and June 30, 2021. All patients were cared for by a university-based fracture/trauma service which includes 6 fellowship trained orthopedic trauma and foot and ankle surgeons. Patient charts within the electronic medical record (EMR) were reviewed and patient weights were recorded. Weight data were reviewed from all of the patient's encounters, not just those with their ankle surgeon. The weight used by the anesthesia team during their preoperative evaluation was used as the patient's preinjury weight. At our institution, the weight used by the anesthesia team is calculated using weight scales in the hospital bed. Postoperative weights were grouped by time from surgery into our routine postoperative timeline of 3 months (± 4 weeks), 6 months (± 6 weeks), and 1 year (± 8 weeks). Patients with complete weight data were analyzed.

Body mass index (BMI) values were calculated for each

Table 1: Weight Class

Weight Class	BMI (kg/m ²)
Healthy Weight	18.5-24.9
Overweight	25.0-29.9
Obese Class 1	30.0-34.9
Obese Class 2	35.0-39.9
Obese Class 3	>40.0

patient and recorded using the units "kg/m²". Patients were grouped into the following categories based on BMI values: healthy weight, overweight, obese class 1, obese class 2, obese class 3^{14,15} (Table 1). For the purposes of reporting our results, obesity class 2 and 3 were combined and reported as one group.

Student's t-test (SPSS) was used for statistical analysis to compare weight and BMI at time of surgery to each follow up timepoints. Subgroup analyses were performed to analyze weight gain in men and women as well as weight gain in different pre-operative BMI groups (<25, 25-29, 30-34, and ≥ 35); weight and BMI changes were compared as above. Student's t-, chi-square, and Fisher's exact tests (SPSS) were used. Statistical significance was set as p-value <0.05.

Results

526 patients underwent open reduction internal fixation for treatment of a bimalleolar or trimalleolar ankle fracture during this study period. 56 of these patients had weight data for the first year postoperatively. The two groups had no statistically significant differences with regard to sex, laterality, smoking status, comorbidities (estimated using the American Society of Anaesthesiologists (ASA) Physical Status score¹⁶), age, height, pre-operative weight and BMI, time to fixation, and time to weightbearing (Table 2).

Demographic data of patients are shown in Table 2. The mean age at surgery was 44.6 ± 16.2 years. There were 27 women and 29 men. At time of surgery, the mean weight was 197.2 ± 53.9 lbs and BMI was 30.3 ± 7.0 kg/m². The mean time to weightbearing across our cohort was 53.0 ± 16.6 days.

The mean time to follow-up, mean weight, BMI, and changes at each postoperative visit are shown in Table 3 and Figures 1 and 2. At 6 months postoperative, there was an increase in weight and BMI, however, this increase was not statistically significant (10.6 lbs and 1.6 points, respectively, $p > 0.05$). At 1 year postoperative, the mean weight was 219.2 ± 51.6 lbs and BMI was 33.8 ± 7.0 kg/m², representing statistically significant increases of 22.0 lbs and 3.4 BMI points compared to preoperative weights ($p = 0.0491$ and 0.0330 , respectively). 7 patients (13%) lost weight during the year post-surgery.

Table 2: Comparison of Demographic Data Between Study Group and Patients without Weight Data

	Study Group (N=56)	Patients without Weight Data (N=470)	p-value
Sex			
Male	29	245	1
Female	27	224	
Laterality			
Right	27	239	0.11
Left	29	161	
Smoking			
Never	20	217	0.93
Former	14	93	
Current	22	158	
Comorbidities			
ASA 1	5	69	0.424
ASA 2	26	218	
ASA 3	21	158	
ASA 4	0	7	
	Mean (SD)		
Age (years)	44.6 ± (16.2)	45.5 ± (17.3)	0.714
Height (inches)	67.4 ± (4.3)	68.5 ± (13.7)	0.556
Pre-Op Weight (lbs)	197.2 ± (53.9)	202.9 ± (57.9)	0.485
Pre-Op BMI (kg/m ²)	30.3 ± (7.1)	31.1 ± (8.3)	0.497
Time to Fixation (days)	5.9 ± (8.3)	6.9 ± (17.0)	0.673
Time to Weightbearing (days)	53.0 ± (16.6)	54.8 ± (25.1)	0.642

ASA = American Society of Anaesthesiologists Physical Status score; BMI = body mass index

Table 3: Weight and BMI at Post-Operative Visits

	Pre-Op	3 months	6 months	1 year
N	56	55	49	39
Time from Surgery (days)	-	86.9 ± (17.3)	175.4 ± (48.8)	326.2 ± (79.2)
Weight (lbs)	197.2 ± (53.9)	199.5 ± (52.2)	207.9 ± (52.6)	219.2 ± (51.6) *
BMI (kg/m ²)	30.3 ± (7.1)	30.7 ± (6.9)	31.9 ± (7.2)	33.8 ± (7.1) *
Weight Change	-	2.3	10.6	22.0
BMI Change	-	0.4	1.6	3.2

* Statistically significant differences from pre-operative measure (p<0.05).

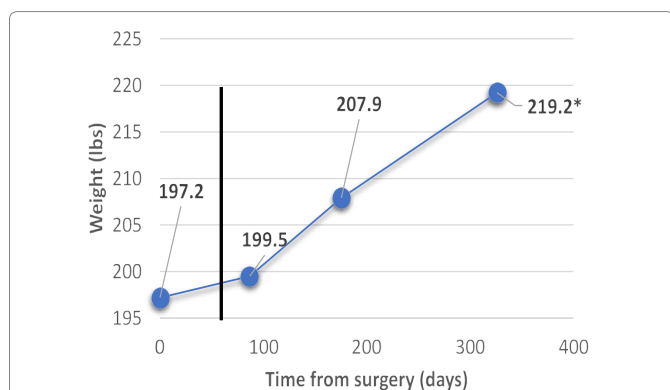


Figure 1: Weight changes over time. On average, patients gained 22 lbs at 1 year compared to their pre-operative weight (p<0.05). The black line indicates transition from non-weightbearing to weightbearing as tolerated.

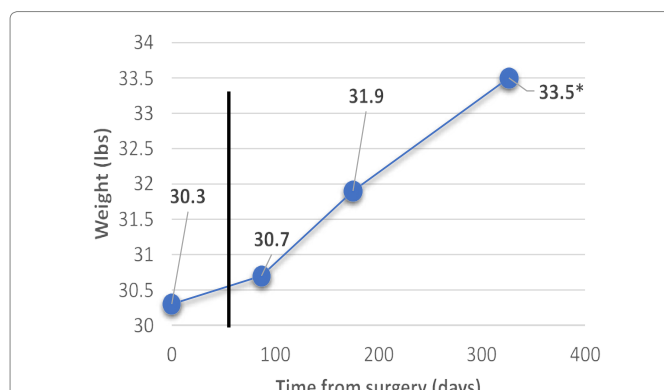


Figure 2: BMI changes over time. On average, patients gained 3.2 BMI points at 1 year compared to their pre-operative BMI (p<0.05). The black line indicates transition from non-weightbearing to weightbearing as tolerated.

Changes in weight between preoperative values and values at each time point were measured for men and women (Figure 3). When comparing the preoperative

weight to weight obtained at 1 year postoperative, men gained an average of 14.4 lbs and 2.7 BMI points, but these increases were not statistically significant (p=0.350 and

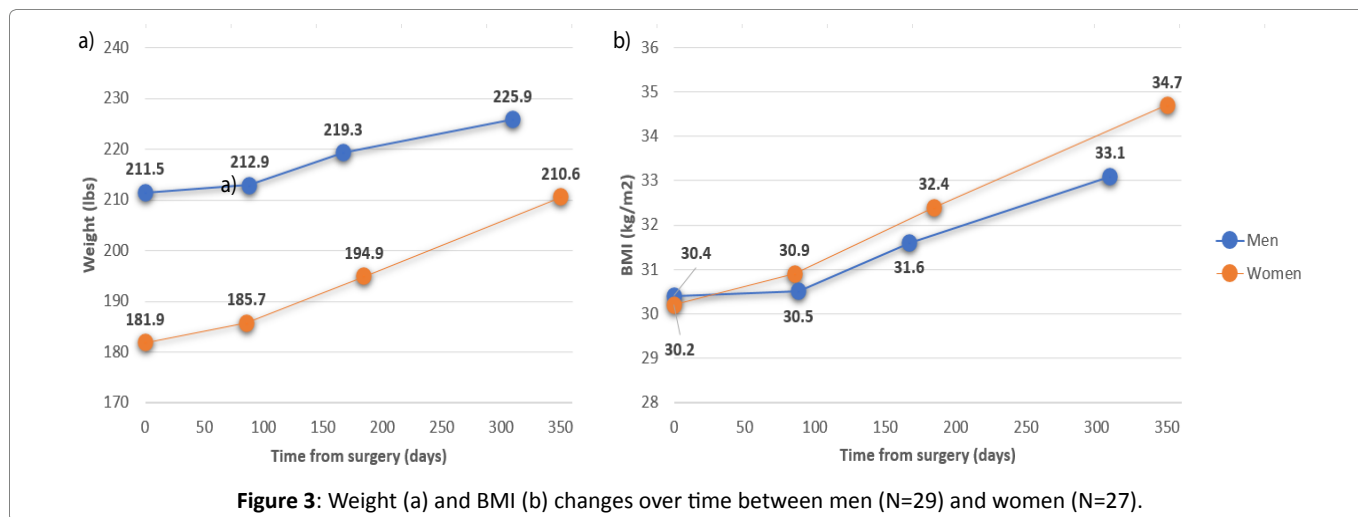


Figure 3: Weight (a) and BMI (b) changes over time between men (N=29) and women (N=27).

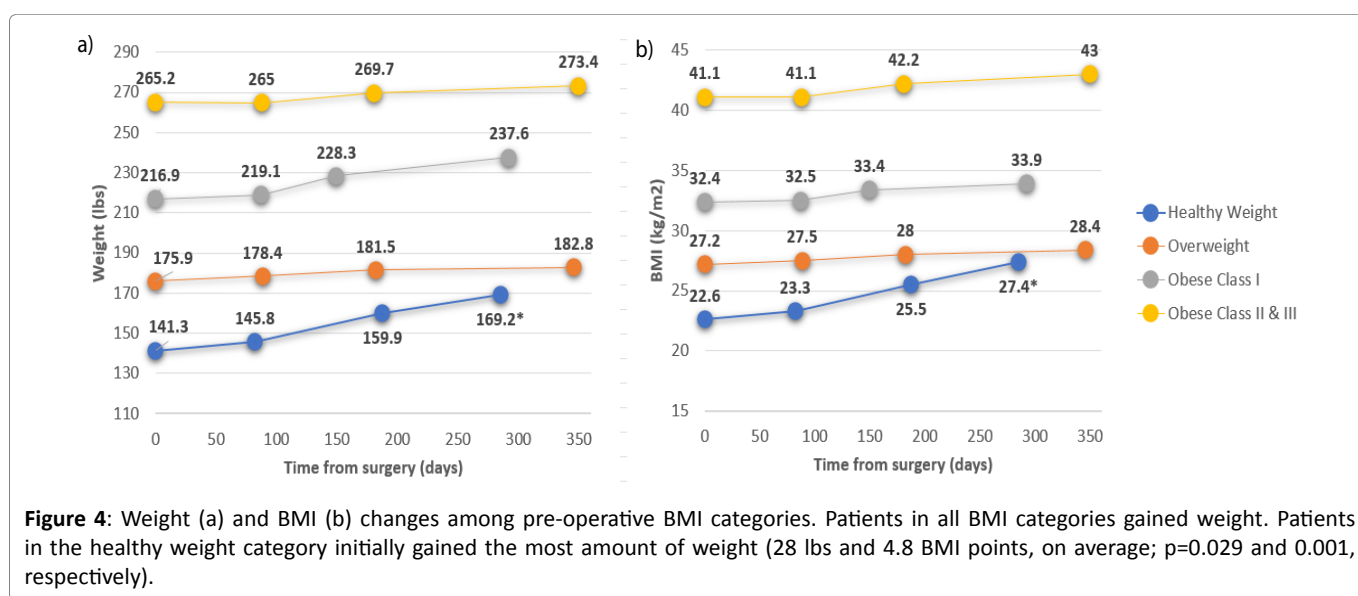


Figure 4: Weight (a) and BMI (b) changes among pre-operative BMI categories. Patients in all BMI categories gained weight. Patients in the healthy weight category initially gained the most amount of weight (28 lbs and 4.8 BMI points, on average; p=0.029 and 0.001, respectively).

0.173, respectively). When comparing the preoperative weight to weight obtained at 1 year postoperative, women gained an average of 28.7 lbs and 4.4 BMI points, but these increases were not statistically significant (p=0.068 and 0.060, respectively).

A subgroup analysis of patients within different preoperative BMI groups (<25, 25-29, 30-34, and ≥35) was performed (Figure 4). Patients in all BMI categories were found to have increases in weight and BMI, but only patients within the healthy BMI category preoperatively (<25) experienced a statistically significant increase in weight and BMI (28 lbs and 4.8 BMI points, on average; p=0.029 and 0.001, respectively). Of the 11 patients in the healthy weight category preoperatively, 6 (55%) were classified in the overweight category at 1 year postoperative.

Discussion

The purpose of our study was to evaluate weight changes over the course of a year following open reduction

internal fixation of bimalleolar and trimalleolar ankle fractures. Our results demonstrate that weight and BMI remain relatively constant during the first 3 months following surgery but begin to increase from then on. At 6 months post-surgery, although not significantly different than preoperative measures, patients were found to gain on average about 10 lbs and about 1.5 BMI points. By 1 year post-surgery, patients gained an average of 22 lbs and 3.4 BMI points, both of which were statistically significantly more compared to their preoperative weights. Only 7 patients (13%) lost weight during this same time frame.

Upon assessment of weight gain based on preoperative BMI categories, all BMI categories experienced weight gain. Interestingly, however, only patients with a preoperative BMI of less than 25 experienced a statistically significant increase in weight over a one year period. This finding is especially noteworthy in light of the fact that once patients gain weight or enter into a new elevated BMI category, their chances of losing weight and entering the “healthy weight” category

again significantly decreases¹⁷⁻¹⁹. One potential reason for the statistically significant weight gain in the group with a BMI of less than 25 is that this group was more active at baseline, so the decrease in activity level was more profound whereas patients with an elevated BMI most likely already had low baseline level of activity prior to surgery.

These results also show that both men and women are susceptible to gaining weight, and although these increases were not statistically significant, they may represent clinically significant increases. Research suggests that patients between the ages of 20-35 gain an average of 1 to 2 pounds per year which is much lower than the weight gain of both males and females in this study²⁰. Even though the average age of this study cohort, 44 years old, is older than that patient demographic, any degree of weight gain could be seen as detrimental since weight gain has been shown to have a dose-response effect on hypertension and overall metabolic health^{21,22}. Moreover, elevated BMI has been shown to significantly increased risk for arthritis and eventual joint replacement in orthopedic patients²³⁻²⁵.

Not every patient is expected to follow up with their orthopedic surgeon or even be seen by their primary care provider for up to one year post-surgery, but this study revealed that even when patients did report to the clinic, their weights were oftentimes not recorded. This data is important information for both the orthopedic provider and the primary care provider as they counsel patients throughout the rehabilitation process. Lack of attention paid to patient weight is concerning since postoperative patients are at risk of weight gain secondary to decreased activity levels caused by postoperative immobility, altered gait mechanics, pain, and posttraumatic osteoarthritis²⁶⁻³⁰. This study highlights the need for more research into the effects of orthopedic surgery on weight fluctuations after surgery. Currently, research on this topic is very limited and published manuscripts only pertain to the arthroplasty population. Moreover, the results lack strong conclusions as evidenced by a systematic review composed of only 8 articles which came to the weak conclusion that weight gain appears to be more common than weight loss following joint replacement⁹⁻¹².

There are limitations to our study. First, this is a retrospective analysis, and, despite our institution-wide EMR, many patients lacked complete weight which places this study at risk for sampling bias. To account for this limitation, we performed statistical analysis between the study cohort and the entire ankle fracture population. This analysis showed no differences across all variables we collected, indicating our study group was representative of the larger group (Table 1). Moreover, although the baseline weight values were standardized, we cannot verify the method of collection for weight values at follow-up encounters.

Conclusion

This is the first study to evaluate weight changes following ankle fracture. This study showed that at 1 year patients recovering from ankle open reduction internal fixation gain an average of 22 lbs and 3.4 BMI points. Patients with a pre-operative BMI of <25 are subject to statistically significant increases in weight. We recommend monitoring patients' weight and counseling them on the risks of weight gain. Further research is necessary to better characterize the risk of weight gain following orthopedic surgery.

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