

## Purpose

- Determine predictors of falls after foot and ankle reconstructive surgery in patients with unilateral non-weight bearing status of the lower extremity.
- Determine fall rates and adverse outcomes of falls after reconstructive foot and ankle surgery in this patient population

## Methodology and Procedures

- The Hennepin Healthcare Institutional Review Board (IRB) approved this retrospective, multi-center cohort study at the Hennepin site; Allina Health IRB determined this project was exempt from IRB review.
- Inclusion criteria:** Surgery on the foot or ankle with procedures in Table 1 performed between January 2017 and January 2018. A period of unilateral non-weight bearing to the lower extremity during the post-operative recovery. Same day surgery.
- Exclusion Criteria:** Non-ambulatory at baseline. If patients received postoperative care in a Transitional care facility.
- Patient medical records of those who fell were reviewed to evaluate for predictors or risk factors of falls and compared to a control group of patients who did not fall
- All data were expressed as means +/- SD. Differences between groups were determined with Fisher's exact test. A P value of  $\leq 0.05$  was considered statistically significant. Univariable regression analysis was used to provide estimates of odds ratios (ORs) for associations in patients with and without falls.

CPT Code	Procedure - TABLE 1
27814	OPEN REPAIR OF BIMALLEOLAR FX
27822	OPEN RX TRIMALLEOLAR FX
27823	OPEN RX TRIMALLEOLAR FX, FIX POST LIP
27826	OPEN RX WEIGHTBEAR TIB, FIX FIB ONLY
27827	OPEN RX WEIGHTBEAR TIB, FIX TIB ONLY
27828	OPEN RX WEIGHTBEAR TIB, FIX TIB/FIB
28118	EXOSTECTOMY POSTERIOR RIGHT HEEL WITH ACHILLES TENDON REPAIR PRONE
28238	EXCISION OF ACCESSORY NAVICULAR, LEFT FOOT
28297	CORRECT BUNION, LAPIDUS TYPE
28300	OSTEOTOMY HEEL BONE
28315	EXCISION OF FRACTURED FIBULAR SESAMOID LEFT FOOT
28415	OPEN RX HEEL FRACTURE
28465	OPEN RX TARSAI FX, EACH
28485	OPEN RX METATARSAL FRACTURE
28615	OPEN RX TAR-METATARSAL DISLOCATION
28725	FUSION FOOT BONES, SUBTALAR
28730	FUSION FOOT BONES, MIDTARSAL, MULTI
28740	FUSION FOOT BONE, MIDTARSAL, 1 JT
28750	FUSION BIG TOE, MT-P JT

## Results

- Demographics (Table 2):** 130 patients, average age 43, 58.5% female, crutches and knee scooter being the most common used devices. Patients were non-weight bearing on average for 39.7 days. Four patients were lost to follow up.

Demographics Table 2	Cohort	No Fall	Fall	P-Value
Patients (%)	130	109 (83.9)	21 (16.1)	
Age mean (SD)	43.0 (15.6)	42.7 (15.9)	44.7 (14.0)	0.586
Gender Female (%)	76 (58.5)	63 (57.8)	13 (61.9)	0.812
BMI mean (SD)	29.5 (6.4)	29.4 (6.6)	29.9 (5.5)	0.774
Operative Location (%)				
Forefoot	74 (56.9)	58 (53.2)	16 (76.2)	0.147
Midfoot	7 (5.4)	6 (5.5)	1 (4.8)	0.147
Rearfoot	13 (10)	11 (10.1)	2 (9.5)	0.147
Ankle	36 (27.7)	34 (31.2)	2 (9.5)	0.147
Past Medical History (%)				
Alcoholism	12 (9.2)	7 (6.4)	5 (23.8)	0.025
Drug abuse	19 (14.6)	14 (12.8)	5 (23.8)	0.192
History of Falls	25 (19.2)	22 (20.1)	3 (14.3)	0.763
Vision Impairment	4 (3.1)	4 (3.7)	0 (0)	0.16
Balance Impairment	17 (13.1)	13 (11.9)	4 (19.1)	0.16
Urinary or Bowel Incontinence	2 (1.5)	2 (1.8)	0 (0)	0.16
Seizure Disorder	1 (0.77)	0 (0)	1 (4.8)	0.16
Auditory & Balance Impairment	2 (1.5)	1 (0.92)	1 (4.8)	0.16
Diabetes	11 (8.5)	7 (6.4)	4 (19.1)	0.078
Greater than one Medical Diagnosis (%)	73 (56.6)	60 (55.6)	13 (61.9)	0.638
Ambulatory Aid (%)				
Crutches	100 (76.9)	82 (75.2)	18 (85.7)	0.402
Knee Scooter	87 (66.9)	67 (61.5)	20 (95.2)	0.002
Walker	23 (17.7)	19 (17.4)	4 (19.1)	1
Knee Walker	2 (1.5)	2 (1.8)	0 (0)	1
Wheelchair	9 (6.9)	6 (5.5)	3 (14.3)	0.16
Physical Therapy Training on Ambulatory Aid (%)	44 (33.9)	33 (30.3)	11 (52.4)	0.076
Physical Therapy Training on Ambulatory Aid Preoperatively (%)	16 (12.3)	14 (12.8)	2 (9.52)	1
Days Non-weight Bearing mean (SD)	39.7 (18.5)	39.5 (18.5)	40.6 (19.1)	0.801
Lost to follow up (%)	4 (3.1)	3 (2.8)	1 (4.8)	1

## Results (continued)

- Fall Events**
- 21 (16.1%) patients fell, on average 14.4 days after surgery, most common in the months of June, May, and October. At the time of fall, 52.4% of patients were immobilized in a posterior splint. Injuries occurred in 19.1% of patients that fell. The ambulatory aid used during falls was 42.9% knee scooter, 28.6% crutches, 4.8% walker. 23.8% of patients were not using their ambulatory aid during the fall (non-compliant). Injuries included: an ankle sprain treated with ankle brace, bruising to thigh, displacement of previously fixated metatarsal fracture not requiring repeat surgical intervention, and a wrist fracture treated nonoperatively. Of the 21 patients who fell, 4 (19%) had a repeat fall.
- Risk Factors (Table 3):** Past Medical History (PMH) of alcoholism (was a statistically significant predictor of falls with a P-value 0.019. Knee scooter use was also statistically significant predictor of falls with a P-value 0.015.

Risk Factors Table 3	Odds Ratio (95% Confidence Interval)	P-Value
Age	1.01 (0.98, 1.04)	0.583
Gender Male	0.84 (0.32, 2.20)	0.727
BMI	1.01 (0.94, 1.09)	0.772
Right Foot	2.02 (1, 8.53)	0.05
Days Non-Weight Bearing	1 (0.98, 1.03)	0.8
Past Medical History		
Alcoholism	4.55 (1.29, 16.10)	0.019
Drug Abuse	2.12 (0.67, 6.70)	0.2
History of Falls	0.66 (0.18, 2.44)	0.532
Greater than one Medical Diagnosis	1.3 (0.50, 3.39)	0.592
Vision Impairment, Balance Impairment, Urinary/Bowel Incontinence, Seizure disorder, or Auditory and Balance impairment	1.34 (0.96, 1.88)	0.083
Diabetes	3.42 (0.91, 12.98)	0.07
Ambulatory Aid		
Crutches	1.98 (0.54, 7.23)	0.304
Knee Scooter	12.54 (1.62, 96.91)	0.015
Walker	1.12 (0.34, 3.69)	0.859
Wheelchair	2.86 (0.66, 12.49)	0.162
Physical Therapy Training on Ambulatory Aid	2.53 (0.98, 6.54)	0.055
Physical Therapy Training on Ambulatory Aid Pre-Operatively	0.71 (0.15, 3.40)	0.673

## Literature Review

- Fall associated fractures are a significant source of morbidity and mortality.<sup>1</sup> Medical costs each year nationwide are estimated at nearly \$30 Billion due to falls.<sup>2</sup> Fall prevention has been studied extensively for inpatient and long-term care facilities.<sup>3,4</sup> Falls among the elderly have also been studied extensively in the community setting.<sup>5</sup> However, the incidence of fall after foot and ankle surgery in the unilateral non-weight bearing individual is not well studied in the literature, nor are the factors that lead to falls.<sup>6</sup>

## Impact Statements

- A PMH of alcoholism was significantly associated with a post-operative fall.** This is consistent with previous studies in the elderly. A 2004 prospective cohort study by Mukamal et al. with 5,841 participants found that "consumption of 14 or more drinks per week is associated with an increased risk of subsequent falls" in adults aged 65 years or older.<sup>7</sup>
- Use of a knee scooter as an ambulatory aid was significantly associated with falls.** A 2017 retrospective survey evaluation of 73 patients reported that 40% of patients (32/73) who used scooters after foot and ankle surgery experienced falls while using the scooter.<sup>9</sup> A 2020 survey of 316 orthopedic surgeons estimated the prevalence of postoperative knee scooter-related injuries to be 2.5%.<sup>10</sup> A 2009 systematic review attempted to assess the effectiveness of mobility device interventions. However, after the review they were unable to "draw any general conclusions about the effectiveness of mobility device interventions".<sup>11</sup> Difficulty exists in determining the "best" device to aid with non-weight bearing due to variability in environmental support, patient expectations, and the prerequisites of the device itself.<sup>11</sup>
- 33.9% of patients in this study received physical therapy to aid with ambulatory aid training. 12.3% of patients received preoperative physical therapy, however **neither preoperative or postoperative ambulatory aid training by PT reduced the risk of falls.**
- 16.1% of patients fell and 19.1% of patients were injured by the fall. This is comparable to previous studies. Kronzer et al. in 2016 performed a systematic literature review regarding the occurrence, injuries, and risk factors of preoperative and postoperative falls. They found that injuries from postoperative falls occurred in 10-70% of fallers, and 5-20% experience severe injury.<sup>13</sup> Although the injuries in our study were able to be managed without return to the operating room, falls postoperatively are not always benign. A survey study of knee scooter related injuries noted that operative treatment of injury was reported by 34% (57/166) of respondents.<sup>10</sup> This illustrates the need for further research to reduce falls post-operatively.

## Limitations

- Activity was not documented in 85.7% of fall events. If a fall occurred that wasn't documented within the Hennepin and Allina Healthcare system, and the patient reported to an outside hospital system, the event could have been missed.
- Medications that the patient was taking were not included in our study. Previous studies have shown that prescription medications such as sedative-hypnotics, antidepressants, anxiolytics, and diuretics are associated with increased fall risk in the elderly.<sup>8</sup>
- Our sample size of 130 was relatively small. In a greater sample size, we would see an increased number of falls, increasing the power of the study.

## Conclusion

- Conclusion:** A PMH of alcoholism is associated with an increased risk of a fall after unilateral elective foot or ankle reconstructive surgery. When compared to other ambulatory aids, use of a knee scooter was associated with increased risk of a fall. 16.1% of patients fell and 19.1% of them were injured during the fall. Literature regarding falls after elective foot & ankle surgery is limited; there is need for further research to reduce falls post-operatively.

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## Financial Disclosures

- None

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