Predictors of Surgical Management in Weber B Ankle Fractures with a Radiographically Symmetric Mortise: A Multicenter Evaluation of Clinical and Imaging-Based Decision-Making

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Introduction: Isolated Weber B fractures are the most common ankle fracture variant. While appreciable tibiotalar translation often precipitates surgery, management between open-reduction-internal-fixation (ORIF) and conservative treatment remains debated when preliminary non-weightbearing (NWB) films show no substantial medial clear space (MCS) widening relative to the superior clear space (SCS). Surgeons may refer to weightbearing (WB) views, gravity stress views (GSV), or the degree of fibular displacement, but even the choice between WB and GSV films remains inconsistent and debated. With minimal consensus on factors driving management, this study aims to determine surgeon- and patient-specific factors most likely to precipitate ORIF.

Methods: A retrospective chart review was conducted of adults undergoing treatment for Weber B fractures with an intact mortise on initial NWB radiographs at three tertiary hospitals. A total of 338 patients were identified by three expert reviewers, of which 169 controls had undergone conservative nonsurgical management, and 169 cases had undergone surgical fixation. Patient demographics, comorbidities including Charleston Comorbidity Index (CCI), radiographic measurements, and types of radiographs attained—NWB, WB, GSV, computerized tomography (CT), and weightbearing CT (WBCT)—were recorded. Surgeon subspecialty and years of practice, in addition to the patient-specific Area Deprivation Index (ADI) and Social Vulnerability Index (SVI) were also identified. Radiographic measurements of MCS, SCS, lateral clear space (LCS), and tibiofibular overlap (TFO) were measured on anterior-posterior (AP) views on NWB, WB, and GSV films. Three-dimensional fibular displacement (3D FDP) was calculated using the space diagonal formula on measurements of lateral fibular displacement (LFDP) on NWB AP films and anteroposterior and vertical fibular displacement on lateral NWB films. Cases and controls were matched by age, sex, and BMI. Following appropriate univariate analyses, significant variables were normalized by z-scoring and entered into a multivariable logistic regression, with those having a variance inflation factor greater than 5 removed. Statistical significance was set at $P<0.05$.

Results: No differences were observed in primary language, CCI, ADI, or SVI ($P>0.05$ for all) between the ORIF and conservatively managed groups. On univariate analysis, the ORIF group was more likely to have CT ($P=0.01$), WBCT ($P=0.04$), GSV ($P<0.01$), and WB X-ray ($P=0.01$) obtained prior to treatment decision. Amongst assessed radiographic measures, greater 3D FDP and LFDP ($P<0.01$) were associated with patients receiving ORIF, as well as increased TFO, talar declination angle, and increased difference between the MCS and SCS (MCS-SCS) on WB and GSV films (all $P<0.01$). Notably, the specific surgeon patients visited significantly influenced treatment decisions ($P=0.01$). Of assessed comorbidities, only neuropathy was associated with ORIF ($P=0.01$). In multivariable logistic regression, the only independent predictor of ORIF was 3D FDP (OR 0.20; 95% CI 0.08-0.52; $P<0.01$).

Discussion: As 3D FDP on NWB films served as the sole independent predictor of ORIF on multivariable analysis, our data suggests that in equivocal Weber B fractures, surgeons are deviating beyond the historically accepted standard of assessing for an intact and stable tibiotalar relationship and are instead guiding treatment decisions on increases in their assessment of the aggregate fibular displacement seen across multiple radiographic planes. Notably, the act of ordering WB or GSV films, and commonly measured parameters on these radiographs such as MCS-SCS, did not influence the chosen treatment modality. This finding challenges long held assumptions on the individual importance of these ancillary imaging studies, indicating that they may play little practical role in truly guiding management as opposed to findings of fibular displacement, which may serve as the true operative trigger. A limitation to this study is that certain unmeasured patient preferences and physical function assessments may have contributed to treatment decision making, thus warranting prospective studies to incorporate clinical examination amongst other factors to validate fibular displacement-based operative thresholds.

Significance: While the operative fixation of Weber B fractures has historically been determined through the loss of tibiotalar congruity, this study demonstrates a significant departure from such presumed protocols by demonstrating that surgeons may be utilizing their assessments of 3D FDP to guide management in equivocal cases. This shift reveals a critical need to establish validated fibular displacement thresholds for operation and determine their long-term implications, particularly regarding post-traumatic osteoarthritis, to ensure surgical indications remain evidence-based and clinically justified.

Table 1. Multivariable logistic regression of independent predictors for ORIF among patients with intact Weber B ankle fractures with cases and controls matched on age, sex, and BMI. Odds ratios reflect the association of predictors with the likelihood of undergoing closed reduction compared to surgery.

Predictor Variable	n	Coefficient	Standard error	z	Odds Ratio	95% Confidence Interval	*P*-Value
Three-Dimensional FDP on NWB Films (mm)	276	-1.62	0.49	-3.27	0.20	(0.08, 0.52)	**<0.01***
LFDP on NWB AP Films (mm)	276	-0.19	0.34	-0.57	0.82	(0.31, 1.33)	0.57
MCS-SCS on WB Films (mm)	130	-0.58	0.33	-1.79	0.56	(0.30, 1.06)	0.07
TFO (mm)	289	0.02	0.33	0.07	1.02	(0.54, 1.95)	0.94
ADI State	329	-0.25	0.31	-0.82	0.78	(0.43, 1.42)	0.41
Neurological Disease (No v Yes)	327	2.30	1.64	1.40	9.96	(0.40, 249.48)	0.16
CT Obtained Pre-Treatment (No v Yes)	337	-0.36	1.90	-0.19	0.69	(0.02, 28.51)	0.85
WBCT Obtained Pre-Treatment (No v Yes)	337	-1.42	1.40	-1.02	0.24	(0.02, 3.72)	0.31
Gravity Stress Films Obtained (No v Yes)	337	-0.41	0.85	-0.48	0.66	(0.12, 3.51)	0.63

Abbreviations: BMI, Body mass index; AP, Anterior-posterior; MCS, Medial Clear Space; SCS, Superior Clear Space; NWB, Non-weightbearing x-ray; WB, Weightbearing x-ray; FDP, Fibular Displacement; LFDP, Lateral fibular displacement; TFO, Tibiofibular overlap; ADI, Area Deprivation Index; CT, Computerized tomography scan; WBCT, Weightbearing computerized tomography scan. Statistical significance was set at $P<0.05$