Functional outcome 3–6 years after operative treatment of closed Weber B ankle fractures with or without syndesmotic fixation

Stein Erik Utvåg, MD, PhD^{1,2}

Markus Georg Naumann, MD³

Ulf Sigurdson, MD, PhD¹

Knut Stavem, MD, MPH, PhD^{2,4,5}

¹Department of Orthopaedics, Akershus University Hospital, Norway

²Institute of Clinical Medicine, University of Oslo, Norway

³Department of Orthopaedics, Østfold Hospital, Norway

⁴Department of Pulmonary Medicine, Medical Division, Akershus University Hospital, Norway

⁵Health Services Research Unit, Akershus University Hospital, Norway

Corresponding author:

Knut Stavem, ⁵Health Services Research Unit, Akershus University Hospital, Lørenskog, Norway

Email: knut.stavem@medisin.uio.no

Tel.: +47-67968710

Acknowledgements

This work was supported by The Sophies Minde Foundation and Østfold Hospital.

Conflicts of interest

All authors declare that they have no conflict of interest.

Abstract

Background To compare the long-term functional outcomes of patients surgically treated for Weber B ankle fractures with or without syndesmotomic fixation.

Methods In total, 959 adult patients with previous treatment with open reduction and internal fixation (ORIF) for closed ankle fractures were eligible for inclusion in a cross-sectional postal survey 3-6 years after surgery; 645 had Weber B fractures. The survey assessed functional outcomes with three validated ankle questionnaires.

Results In total 365 (57%) patients responded at a median of 4.2 years after the trauma. After adjusting for age, sex, education, smoking status, body mass index, diabetes, physical status before surgery, fracture classification, and duration of surgery, patients with a syndesmotomic fixation had no different OMAS score ($p=0.98$), LEFS score ($p=0.61$), and SEFAS score ($p=0.98$) than those without a syndesmotomic fixation. Trimalleolar fracture was associated with worse functional outcomes than unimalleolar on two of the scales, the OMAS ($p=0.028$) and LEFS ($p=0.046$).

Conclusions In multivariable analysis, patients with a syndesmotomic fixation had no worse long-term functional outcomes than those without syndesmotomic fixation.

Keywords: Closed ankle fracture, Syndesmotomic fixation, Functional outcome, Questionnaire, Open reduction and Internal fixation

1. Introduction

Ankle fractures are common injuries that constitute approximately 9% of all fractures, with an estimated incidence of 101–108 per 100,000 inhabitants per year [1]. About 50% of ankle fractures require surgical stabilization with open reduction and internal fixation (ORIF) [2].

Syndesmotomic instability in closed ankle fractures treated by ORIF is common, and earlier studies have reported syndesmotomic instability in 30-45 % of patients with operatively fixed Weber B fractures [3]. A persistent unstable syndesmosis may lead to early degenerative arthritis characterized by ankle pain and stiffness. Current clinical guidelines recommend intraoperative stability testing of the syndesmosis by the hook test or external rotation stress test [4]. The standard treatment of syndesmosis instability involves static fixation with one or multiple screws through 3 or 4 cortices, although recently treatment with dynamic fixation has gained popularity [5].

To our knowledge, there is limited information on the medium-term (1-3 years) or long-term (> 3 years) impact of a syndesmotomic fixation on the subjects' functional outcome, and whether temporary syndesmotomic repair restores long-term ankle function.

Some previous studies of the clinical consequences of syndesmotomic instability in ankle fractures included all unstable ankle fracture patterns, including Weber C and Maissonneuve fractures, which may have a worse prognosis than perceived more simple fractures [6]. A previous study of a more homogeneous population of patients with operated Weber B fractures reported slightly reduced functional outcomes in univariate analysis after 1 year among subjects with concomitant syndesmosis instability, than those without such instability [7]. It is not clear if this possible reduction in function may disappear over time.

The objective of this study was to determine whether patients with a temporary syndesmotomic fixation had a comparable functional outcome after 3-6 years as those without such fixation following ORIF for Weber B closed ankle fractures, after adjusting for possible confounding variables.

2. Materials and methods

2.1. Subjects and study design

This was a retrospective cohort study of patients who had surgical treatment (ORIF) for unstable and closed ankle fractures at two Norwegian hospitals, Østfold Hospital and Akershus University Hospital. The hospitals have a combined geographical catchment area of about 730,000 inhabitants, and all patients ≥ 18 years of age living in the catchment area who were treated for unstable and closed ankle fractures by ORIF between January 1, 2009 and December 31, 2011 were eligible for inclusion in the study. Patients were selected from the information systems of the hospitals using discharge diagnoses (10th revision of the International Classification of Diseases: codes S82.3–S82.9, S93.2 and S93.4) [8] combined with surgical procedure codes (Nordic Medico-Statistical Committee Classification of Surgical Procedures: codes NHJ00–NHJ98 and NHE 99) [9]. Details of the study have previously been reported [10].

In total, 1,149 patients were eligible for chart review. We excluded 120 patients living outside the hospitals' catchment area or who were misclassified and 70 patients, who were unable to respond to questionnaires, because they had cognitive problems, could not use the other leg for comparison, had moved out of the area or had died (Fig. 1).

After exclusions, 959 patients were eligible for inclusion in a postal survey. We mailed a questionnaire to the participants in January 2015, and 4 weeks later we sent a reminder to the non-respondents. The questionnaire included the Olerud and Molander Ankle Score (OMAS), the Lower Extremity Functional Scale (LEFS) and the Self-reported Foot & Ankle Questionnaire (SEFAS) and items about demographics. For the analysis in this paper, we selected respondents with Weber B fractures and information on baseline smoking status.

The study was approved by the Norwegian Social Science Data Services (approval no. 28813/5) and the Regional Committees for Medical and Health Research Ethics, Health Region South East (approval no. 2012/384).

2.2. Variables and classifications

2.2.1. Medical record review and variables

All electronic medical records and radiographs were reviewed by one of the authors (M.G.N. or U.S.), They verified diagnoses and procedures and collected information on demographics (age at trauma and sex), body mass index (BMI, in kg/m²), physical status before surgery [American Society of Anesthesiologists (ASA) classes I–III [11]: I, completely healthy fit; II, mild systemic disease; and III, severe systemic disease], diabetes (yes or no), current smoking status (yes, no or unknown), fracture classification (see below), treating hospital and whether surgery was performed within 8 h of trauma. Finally, they recorded preoperative antibiotics given (yes or no), syndesmotic screw fixation (yes or no), and the duration of surgery (in minutes).

2.2.2 Fracture classification and treatment

The radiographs of the patients were classified for descriptive purposes using the Weber classification and into uni-, bi- and trimalleolar fractures [12].

Both hospitals practiced internal fixation of the malleolus in accordance with the AO (Arbeitsgemeinschaft für Osteosynthesefragen) principles [13]. Preoperative radiographs included AP, mortise and lateral view. CT scanning was not part of the routine radiological evaluation. The lateral malleolus was reduced and fixed with a 3.5 mm lag screw and a one-third tubular plate. A fracture on the medial malleolus was reduced and fixed with two cancellous screws; while a fracture of the posterior malleolus was fixed with cancellous screws from anterior to posterior. The operating surgeon then performed the hook test by stabilizing the tibia with one hand while applying a lateral force using a bone hook. This test is considered to be positive and syndesmotic fixation indicated if >2mm of lateralization of the fibula is observed [4]. Syndesmotic fixation was performed with one 4.5 mm quadricortical screw, and acceptable syndesmotic fixation was also confirmed by postoperative radiographs in AP, mortise and lateral view.

Patients were kept partially weight-bearing for 12 weeks if syndesmotic fixation was performed and 6 weeks if not. All syndesmotic screws were routinely removed 10–12 weeks postoperatively.

2.3. Assessment of functional outcomes

In the postal survey the subjects completed three different validated questionnaires to assess functional outcomes.

Olerud and Molander Ankle Score. The OMAS was designed to assess symptoms and function after ankle fractures. It consists of items that are scored in the following domains with ordinal scales: pain (0–25), stiffness (0–10), swelling (0–10), stair climbing (0–10), running (0–5), jumping (0–5), squatting (0–5), supports (0–10) and work/activity level (0–20). The item scores are summed to produce a total score ranging from 0 (totally impaired) to 100 (completely unimpaired). Each item is scored to represent the degree of disability. The total score can be categorized as poor (0–30), fair (31–60), good (61–90) or excellent (91–100) [14].

Self-reported Foot & Ankle Questionnaire. The SEFAS contains 12 questions on an ordinal scale from 1 to 5. The item scores are summed to produce a total score ranging from 12 (normal function) to 60 (most severe disability) [15, 16].

Lower Extremity Functional Scale. The LEFS comprises 20 items related to the ability to perform everyday activities that are scored on the following scale: extreme difficulty or unable to perform activity (0), severe difficulty (1), moderate difficulty (2), minor difficulty (3) or no difficulty (4). The items are summed to produce a total score ranging from 0 (very poor function) to 80 (very good function) [17].

2.4. Statistical analysis

Descriptive statistics are presented as mean (SD or range), median (interquartile range) or number (%) values, as appropriate. Characteristics for respondents and non-respondents and for subjects with and without a syndesmotic fixation were compared using the

independent samples *t*-test or Mann-Whitney *U* test for continuous variables, Fisher's exact test for categorical variables, or Wilcoxon rank sum for ordinal variables.

The association of a syndesmotic fixation with functional outcomes (OMAS, SEFAS, LEFS) were analysed using multivariable linear regression analysis. We chose variables for adjustment based on prior knowledge and availability, and these variables were forced into the models. Multivariable models were used to assess the effect of a syndesmotic fixation (yes or no), adjusting for age, sex, education (<10 years, 10-12 years, >12 years), current smoking (yes or no; subjects with unknown smoking status were excluded from the analysis), BMI (in kg/m²), diabetes (yes or no), ASA class, and duration of surgery. We did not impute missing values before the analysis.

In the regression models, the residuals showed some deviation from normal distributions. Log-transformation or square root transformation of the dependent variable did not materially improve this situation. Therefore, we used the untransformed values for the dependent variable, using bootstrapped 95% confidence intervals, with 500 replications, in all models.

We chose a threshold for statistical significance at $p < 0.05$ in two-sided tests. All statistical analyses were conducted using the Stata software (version 15.1, Stata Corporation, College Station, TX, USA).

3. Results

3.1. Sample and respondents

Of 959 patients that were eligible for the postal survey, 645 had a fracture that was classified as Weber B, of whom 384 (60%) responded to the survey, and 365 of respondents had data on smoking status and were available for further analysis (Fig. 1). The median time between surgery and completion of the questionnaire was 4.2 years (interquartile range 3.8 to 5.1 years, range 3.1 to 6.1 years; $n=365$).

A total of 567 patients (59% of those eligible) completed the questionnaire, 345 patients did not respond and 47 questionnaires were returned unopened due to incorrect

addresses. Respondents with a Weber B fracture (n=365) were older than non-respondents/exclusions with Weber B fracture (n=280), with mean 54.7 (SD 15.1) years and 48.8 (16.8) years, respectively ($p<0.001$), were less likely to be current smokers (25% vs. 39%, $p<0.001$), and were more likely to have received surgery within 8 h (37% vs. 25%, $p=0.001$). There were no differences between respondents and non-respondents/exclusions in sex, BMI, ASA class, diabetes, duration of surgery, or treating hospital (data not shown).

In total, 125 of the 365 respondents (34%) and 97 of the 280 non-respondents/exclusions (35%) had a syndesmotic fixation ($p=0.93$). Respondents with a syndesmotic fixation had higher BMI, had a higher propensity for being treated at the Østfold Hospital, had more often preoperative antibiotics, and longer surgery times than those without a syndesmotic fixation (Table 1).

3.2. Functional outcomes

In bivariate comparisons of functional outcome scores, patients with a syndesmotic fixation had marginally lower OMAS and LEFS scores and a higher SEFAS scores than those without a syndesmotic fixation (Table 2).

In multivariable analysis after adjusting for several variables, patients with a syndesmotic fixation had similar OMAS ($p=0.98$), LEFS ($p=0.61$), and SEFAS score ($p=0.98$) as those without a syndesmotic fixation (Table 3), indicating no worse functional outcome.

Current smoking and longer duration of surgery were associated with worse functional outcomes on the OMAS, LEFS and SEFAS. Furthermore, in the multivariable models, after adjusting for syndesmotic fixation and other variables, trimalleolar fracture was associated with worse functional outcomes than unimalleolar fractures on two of the scales: the OMAS and LEFS (Table 3).

4. Discussion

The main finding in the present study was that functional outcomes after 3 to 6 years in patients with closed Weber B ankle fractures were no worse for those with a syndesmotic

fixation than for those without such fixation. This finding was consistent and persisted after adjusting for several background variables and possible confounders.

This finding contrasts a previous prospective study with several assessments during the first year, using three different functional outcome measures and a different analytic method. The study reported a slightly detrimental effect of syndesmotic fixation on outcomes of operatively treated supinationexternal rotation type Weber B fractures at 1 year, i.e. patients without syndesmotic injury had better SMFA and Bother scores, but not AOFAS scores [7]. These analyses were, however, not adjusted for possible confounding variables. The present study had a somewhat larger sample, longer follow-up time after surgery, and adjusted for several potentially important confounding variables.

Our findings support a recent study reporting similar functional outcomes for patients with or without syndesmotic instability 6 years after surgical treatment with ORIF for Weber B or C fractures [18], although the analyses were unadjusted and are difficult to interpret because of an imbalance in Weber class between those with and without syndesmotic screw. The present study also supports the finding of equal OMAS, American Orthopedic Foot & Ankle Society ankle hindfoot score and Short Form-36 scores between patients after screw fixation for ankle syndesmosis rupture and patients with an intact syndesmosis [19], and the finding of equal OMAS scores between patients with stable and instable syndesmotic injury patterns 4 to 6 years after treatment for Weber B fractures [20]. In contrast, another study reported more problems in several dimensions of health-related quality of life on average 5 years after syndesmotic damage and stabilization than a general reference population [21].

We adjusted for current smoking, which is known to be associated with functional outcomes [22], and BMI, which is associated with functional outcomes in patients with Weber type-A and -B fractures [22] or only Weber B fractures [23], though this finding is not universal across all studies. Finally, we adjusted for preoperative health status (ASA class), which is associated with functional outcomes at 1 year after surgical treatment for ankle fractures [24].

Class of fracture, such as unimalleolar, bimalleolar, or trimalleolar, may be associated with syndesmotic injury as well as the subjective outcomes. Therefore, the comparison between those with and without syndesmotic fixation was adjusted for this possible confounder in the multivariable models. In the adjusted model, the outcomes for bimalleolar and trimalleolar fractures seemed somewhat worse for trimalleolar and bimalleolar fractures than for unimalleolar, although, only the difference between trimalleolar and unimalleolar fractures on two of the outcome scales was statistically significant. Possibly, this may be related to statistical power and might have been different in a larger study.

The overall syndesmotic fixation rate in the present study was consistent with those of previous studies, also reporting a rate of 30 to 45 % in Weber B fractures [7, 25]. The present study was large and was conducted in two trauma hospitals covering a geographical area that comprises about 14% of the Norwegian population.

We think the response rate to the questionnaires was acceptable and at the level that can be expected for this type of study, and there were few differences in characteristics between respondents and non-respondents. Therefore, the results ought to be representative of the Norwegian setting.

This study focused on Weber B fractures in order to have a more homogeneous sample than some previous studies. Furthermore, the study used three distinct and validated questionnaires: the OMAS, SEFAS and LEFS, and the findings were consistent across all three instruments.

This study had several limitations. The population was identified retrospectively, and variables were collected by chart review, which limits the number, quality and completeness of variables that can be collected. The chart and radiograph reviews were conducted by only one researcher, and the interrater reliability and validity for the data extracted were not assessed. The present study controlled for a number of variables, but some important variables were not available for this retrospective study, such as functional status before surgery, more detailed information on comorbidity, or the operating surgeon's experience. Therefore, residual confounding may have been present.

Syndesmotic instability was identified by the operating surgeon through a perioperative stress examination, which is considered to be a reproducible and validated test for syndesmotic instability [4]. Routine use of CT scanning or MRI may have some advantages in the assessment of syndesmotic injuries or quality of the syndesmotic reduction [26, 27], but this was not available in the present study. It is, however, not clear to what extent the quality of the syndesmotic reduction influences the clinical outcome [28].

The overall rate of syndesmotic screw fixation was high, with a marked difference in the rates between the two hospitals. The catchment area population was similar for the two hospitals, and the guidelines for the surgical procedures were similar. As this was a retrospective study, we have no documentation on the results of intraoperative stress testing, and it is possible that the surgeons at the two hospitals interpreted the intraoperative stress tests differently, or that some performed syndesmotic fixation when there was doubt about the result of the stress test.

It has been suggested that as much as 16 % of the syndesmotic screw fixation in ankle fractures may be unnecessary [29]. If there was an overdiagnosis of syndesmotic injuries in the present study, a number of patients with syndesmotic fixation might have achieved a good functional outcome without syndesmotic fixation.

Finally, in the present study all syndesmotic screws were removed routinely. A recent review has suggested that this may not be necessary, although there is yet insufficient evidence [30], and this will be addressed in a randomized trial [31].

In conclusion, this survey of patients in a historical cohort study found that patients with a syndesmotic fixation in closed Weber B ankle fractures reported no worse functional outcomes than those without such fixation on the OMAS, LEFS and SEFAS at a median of 4.2 years after surgery after adjusting for several background variables and potential confounders.

Acknowledgements

This study received financial support from The Sophies Minde Foundation and Østfold Hospital.

Conflicts of interest

All authors declare that they have no conflict of interest.

References

- [1] Court-Brown CM, Caesar B. Epidemiology of adult fractures: A review. *Injury*. 2006;37(8):691-7.
- [2] Sanders DW, Tieszer C, Corbett B. Operative versus nonoperative treatment of unstable lateral malleolar fractures: a randomized multicenter trial. *J Orthop Trauma*. 2012;26(3):129-34.
- [3] Tornetta P, 3rd, Axelrad TW, Sibai TA, Creevy WR. Treatment of the stress positive ligamentous SE4 ankle fracture: incidence of syndesmotic injury and clinical decision making. *J Orthop Trauma*. 2012;26(11):659-61.
- [4] Pakarinen H, Flinkkila T, Ohtonen P, Hyvonen P, Lakovaara M, Leppilahti J, et al. Intraoperative assessment of the stability of the distal tibiofibular joint in supination-external rotation injuries of the ankle: sensitivity, specificity, and reliability of two clinical tests. *J Bone Joint Surg Am*. 2011;93(22):2057-61.
- [5] Seyhan M, Donmez F, Mahirogullari M, Cakmak S, Mutlu S, Guler O. Comparison of screw fixation with elastic fixation methods in the treatment of syndesmosis injuries in ankle fractures. *Injury*. 2015;46 Suppl 2:S19-23.

- [6] Egol KA, Pahk B, Walsh M, Tejawani NC, Davidovitch RI, Koval KJ. Outcome after unstable ankle fracture: effect of syndesmotic stabilization. J Orthop Trauma. 2010;24(1):7-11.
- [7] Litrenta J, Saper D, Tornetta P, 3rd, Phieffer L, Jones CB, Mullis BH, et al. Does Syndesmotic Injury Have a Negative Effect on Functional Outcome? A Multicenter Prospective Evaluation. J Orthop Trauma. 2015;29(9):410-3.
- [8] WHO-ICD10. ICD-10 International Statistical Classification of Diseases and Related Health Problems 10th Revision [No authors listed.]. WHO-ICD10; 2015
[<http://apps.who.int/classifications/icd10/browse/2015/en>].
- [9] NOMESCO Classification of Surgical Procedures (NCSP), version 1.16. Nordic Medico-Statistical Committee (NOMESCO); 2011
[http://www.nordclass.se/NCSP_1_16.pdf].
- [10] Naumann MG, Sigurdson U, Utvag SE, Stavem K. Associations of timing of surgery with postoperative length of stay, complications, and functional outcomes 3-6 years after operative fixation of closed ankle fractures. Injury. 2017;48(7):1662-9.
- [11] American Society of Anesthesiologists - ASA Physical Status Classification System. 2014 [<http://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system>].
- [12] Broos P, Bisschop A. A new and easy classification system for ankle fractures. Int Surg. 1992;77(4):309-12.
- [13] Rockwood CA, Green DP, Bucholz RW. Rockwood & Green's fractures in adults. 2010.
- [14] Olerud C, Molander H. A scoring scale for symptom evaluation after ankle fracture. Arch Orthop Trauma Surg. 1984;103(3):190-4.
- [15] Hosman AH, Mason RB, Hobbs T, Rothwell AG. A New Zealand national joint registry review of 202 total ankle replacements followed for up to 6 years. Acta Orthop. 2007;78(5):584-91.

- [16] Coster M, Karlsson MK, Nilsson JA, Carlsson A. Validity, reliability, and responsiveness of a self-reported foot and ankle score (SEFAS). *Acta Orthop*. 2012;83(2):197-203.
- [17] Binkley JM, Stratford PW, Lott SA, Riddle DL. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. North American Orthopaedic Rehabilitation Research Network. *Phys Ther*. 1999;79(4):371-83.
- [18] Veen EJ, Zuurmond RG. Mid-term results of ankle fractures with and without syndesmotic rupture. *Foot Ankle Surg*. 2015;21(1):30-6.
- [19] Kohake MBJ, Wiebking U, O'Loughlin PF, Krettek C, Gaulke R. Mid- to Long-term Outcomes After Weber B-type Ankle Fractures With and Without Syndesmotic Rupture. *In Vivo*. 2019;33(1):255-61.
- [20] Kortekangas T, Flinkkila T, Niinimäki J, Lepojarvi S, Ohtonen P, Savola O, et al. Effect of syndesmosis injury in SER IV (Weber B)-type ankle fractures on function and incidence of osteoarthritis. *Foot Ankle Int*. 2015;36(2):180-7.
- [21] van Vlijmen N, Denk K, van Kampen A, Jaarsma RL. Long-term Results After Ankle Syndesmosis Injuries. *Orthopedics*. 2015;38(11):e1001-6.
- [22] Still GP, Atwood TC. Operative outcome of 41 ankle fractures: a retrospective analysis. *J Foot Ankle Surg*. 2009;48(3):330-9.
- [23] Van Schie-Van der Weert EM, Van Lieshout EM, De Vries MR, Van der Elst M, Schepers T. Determinants of outcome in operatively and non-operatively treated Weber-B ankle fractures. *Arch Orthop Trauma Surg*. 2012;132(2):257-63.
- [24] Egol KA, Tejwani NC, Walsh MG, Capla EL, Koval KJ. Predictors of short-term functional outcome following ankle fracture surgery. *J Bone Joint Surg (Am)*. 2006;88-A(5):974-9.
- [25] Jenkinson RJ, Sanders DW, Macleod MD, Domonkos A, Lydestadt J. Intraoperative diagnosis of syndesmosis injuries in external rotation ankle fractures. *J Orthop Trauma*. 2005;19(9):604-9.

- [26] van Zuuren WJ, Schepers T, Beumer A, Sierevelt I, van Noort A, van den Bekerom MPJ. Acute syndesmotic instability in ankle fractures: A review. *Foot Ankle Surg.* 2017;23(3):135-41.
- [27] van den Heuvel SB, Dingemans SA, Gardenbroek TJ, Schepers T. Assessing Quality of Syndesmotic Reduction in Surgically Treated Acute Syndesmotic Injuries: A Systematic Review. *J Foot Ankle Surg.* 2019;58(1):144-50.
- [28] Warner SJ, Fabricant PD, Garner MR, Schottel PC, Helfet DL, Lorch DG. The Measurement and Clinical Importance of Syndesmotic Reduction After Operative Fixation of Rotational Ankle Fractures. *J Bone Joint Surg Am.* 2015;97(23):1935-44.
- [29] Weening B, Bhandari M. Predictors of functional outcome following transsyndesmotic screw fixation of ankle fractures. *J Orthop Trauma.* 2005;19(2):102-8.
- [30] Dingemans SA, Rammelt S, White TO, Goslings JC, Schepers T. Should syndesmotic screws be removed after surgical fixation of unstable ankle fractures? a systematic review. *Bone Joint J.* 2016;98-b(11):1497-504.
- [31] Dingemans SA, Birnie MFN, Sanders FRK, van den Bekerom MPJ, Backes M, van Beeck E, et al. Routine versus on demand removal of the syndesmotic screw; a protocol for an international randomised controlled trial (RODEO-trial). *BMC Musculoskelet Disord.* 2018;19(1):35.

Figure legend

Figure 1. Flow chart of the study. SF=syndesmosis fixation.

Table 1

Respondent characteristics at admission and injury data. Data are number (%) values except where stated otherwise ($n=365$)

	No syndesmotic fixation ($n=240$)	Syndesmotic fixation ($n=125$)	p
Age, years, mean (range)	55.0 (18.1–86.2)	54.2 (19.3–84.7)	0.64***
Sex, female	152 (63)	83 (66)	0.65*
Education			0.37**
<11 yrs	66 (28)	38 (32)	
11–13 yrs	83 (35)	42 (36)	
>13 yrs	85 (36)	38 (32)	
BMI, kg/m ² , mean (range)	26.8 (19.5–70.0)	28.4 (20.1–45.0)	0.002***
Treating hospital			<0.001*
Akershus University Hospital	133 (55)	44 (35)	
Østfold Hospital	107 (45)	81 (65)	
Physical status, ASA class			0.07**
I Completely healthy fit	86 (35)	33 (26)	
II Mild systemic disease	143 (60)	85 (68)	
III Severe systemic disease	11 (5)	7 (6)	
Diabetes	12 (5)	11 (9)	0.18*
Current smoking	64 (27)	29 (23)	0.53*
Modified fracture classification ¹			0.20**
Unimalleolar	119 (50)	55 (44)	
Bimalleolar	52 (22)	38 (30)	
Trimalleolar	69 (29)	32 (26)	
Surgery within 8 hours	89 (37)	48 (38)	0.82*
Preoperative antibiotics ($n=364$)	134 (56)	93 (74)	0.001*
Duration of surgery in minutes, median (IQR)	77.5 (56–104)	85 (67–112)	0.01***

*Fisher's exact test, **Wilcoxon's rank sum test, ***Mann-Whitney U test,

¹Broos & Bisschop

IQR=interquartile range, ASA=American Society of Anesthesiologists, BMI=body mass index

Table 2

Functional outcomes following open reduction and internal fixation in patients with Weber B closed ankle fractures

	No syndesmotic fixation			Syndesmotic fixation			<i>p</i> [*]
	<i>n</i>	Median	IQR	<i>n</i>	Median	IQR	
OMAS (range 0–100) ¹	203	85	65–100	96	80	60–97.5	0.33
LEFS (range 0–80) ¹	233	75	61–80	116	72	59–79	0.18
SEFAS (range 12–60) ²	234	16.7	13–26	120	18	13.5–26	0.22

*Mann-Whitney *U* test: ¹ higher score denotes better function, ² lower score denotes better function

OMAS=Olerud and Molander Ankle Score, LEFS=Lower Extremity Functional Scale, SEFAS=Self-Reported Foot & Ankle Questionnaire, IQR=interquartile range

Table 3

Functional outcomes at a median of 4.2 years after open reduction and internal fixation in Weber B closed ankle fractures. Results of multivariable linear regression analysis

	OMAS (<i>n</i> =257) (range 0–100)			LEFS (<i>n</i> =299) (range 0–80)			SEFAS (<i>n</i> =303) (range 12–60)		
	β	95% CI	p	β	95% CI	p	β	95% CI	p
Syndesmosis fixation	-0.08	-5.41 to 5.24	0.98	-0.92	-4.47 to 2.63	0.61	-0.03	-2.13 to 2.08	0.98
Age, increase of 10 years	-0.59	-2.80 to 1.62	0.60	-1.09	-2.35 to 0.16	0.088	0.05	-0.77 to 0.88	0.90
Sex, male	1.28	-4.15 to 6.71	0.64	1.97	-1.83 to 5.77	0.31	-0.81	-3.07 to 1.44	0.48
Education									
11–13 yrs	6.39	-1.06 to 13.84	0.093	4.29	-0.20 to 8.77	0.061	-1.10	-4.00 to 1.80	0.46
>13 yrs	3.30	-4.40 to 11.01	0.40	5.58	1.05 to 10.10	0.016	-0.58	-3.46 to 2.31	0.69
Current smoking	-11.54	-17.78 to -5.29	<0.001	-4.61	-8.47 to -0.75	0.019	3.80	1.16 to 6.45	0.005
BMI, kg/m ²	-0.70	-1.29 to -0.11	0.020	-0.20	-0.50 to 0.10	0.19	0.11	-0.11 to 0.33	0.32
Diabetes, yes	-4.03	-19.88 to 11.83	0.62	-6.60	-13.93 to 0.74	0.078	5.30	0.03 to 10.56	0.049
Physical status (ASA class)									
II Mild systemic disease	-2.74	-8.85 to 3.37	0.38	-1.08	-4.35 to 2.19	0.52	1.52	-0.70 to 3.75	0.18
III Severe systemic disease	-0.09	-11.53 to 11.35	0.99	-8.93	-19.39 to 1.52	0.094	1.45	-4.93 to 7.83	0.66
Duration of surgery, per 15 minutes	-1.94	-3.32 to -0.56	0.006	-0.92	-1.75 to -0.09	0.031	0.70	0.13 to 1.28	0.017
Time after surgery, years	3.37	0.29 to 6.44	0.032	0.98	-0.96 to 2.91	0.32	-1.05	-2.27 to 0.17	0.091
Modified fracture classification ¹									
Bimalleolar	-7.24	-14.90 to 0.41	0.064	-4.60	-9.52 to 0.32	0.067	2.90	-0.04 to 5.85	0.054
Trimalleolar	-8.71	-16.94 to -0.47	0.038	-4.90	-9.70 to -0.09	0.046	2.88	-0.29 to 6.04	0.075

CI, confidence interval

¹Broos & Bisschop