BMJ Open

Non-operative versus operative treatment of suprasyndesmotic ankle fractures: protocol for a prospective, multicentre, randomised controlled trial

Ola Saatvedt ,[1,2] Martin Riiser,[2,3] Frede Frihagen,[4] Wender Figved,[5] Jan Erik Madsen,[2,3] Marius Molund,[4] Håvard Furunes[1,2]

To cite: Saatvedt O, Riiser M, Frihagen F, *et al*. Non-operative versus operative treatment of suprasyndesmotic ankle fractures: protocol for a prospective, multicentre, randomised controlled trial. *BMJ Open* 2024;**14**:e075122. doi:10.1136/bmjopen-2023-075122

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2023-075122).

Received 26 April 2023
Accepted 20 December 2023

[1]Department of Orthopedic Surgery, Innlandet Hospital Trust Gjøvik Hospital, Gjovik, Norway
[2]University of Oslo Faculty of Medicine, Oslo, Norway
[3]Department of Orthopedic Surgery, Oslo Universitetssykehus, Oslo, Norway
[4]Department of Orthopedic Surgery, Østfold Hospital Trust, Sarpsborg, Norway
[5]Department of Orthopaedic Surgery, Bærum Hospital, Vestre Viken Hospital Trust, Bærum, Norway

Correspondence to
Dr Ola Saatvedt;
ola.saatvedt@gmail.com

ABSTRACT

Introduction Surgery is widely recognised as the treatment of choice for suprasyndesmotic ankle fractures, because of the assumption that these injuries yield instability of the ankle joint. Stability assessment of ankle fractures using weightbearing radiographs is now used regularly to guide the treatment of transsyndesmotic and infrasyndesmotic ankle fractures. Patients with a congruent ankle joint on weightbearing radiographs can be treated non-operatively with excellent results. Weightbearing radiographs are, however, rarely performed on suprasyndesmotic fractures due to the assumed unstable nature of these fractures. If weightbearing radiographs can be used to identify suprasyndesmotic fractures suitable for non-operative treatment, we may save patients from the potential burdens of surgery.

Our aim is to compare the efficacy of operative and non-operative treatment of patients with suprasyndesmotic ankle fractures that reduce on weightbearing radiographs.

Methods and analysis A non-inferiority randomised controlled trial involving 120 patients will be conducted. A total of 120 patients with suprasyndesmotic ankle fractures with an initial radiographic medial clear space of <7 mm will be subjected to weightbearing radiographs. If the tibio-talar joint is completely reduced, we will randomise in a 1:1 ratio to either operative treatment including reduction and fixation of the syndesmosis or non-operative treatment with an orthosis. The primary study outcome is patient-reported ankle function and symptoms as measured by the Olerud-Molander Ankle Score at 2-year follow-up. Secondary outcomes include the Manchester-Oxford Foot Questionnaire, range of motion, radiographic results and rates of adverse events.

Ethics and dissemination The Regional Committee for Medical and Health Research South East, group A (permission number: 169307), has granted ethics approval. The results of this study will provide valuable insights for developing future diagnostic and treatment strategies for a common fracture type. The findings will be shared through publication in peer-reviewed journals and presentations at conferences.

Trial registration number NCT04615650.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Non-inferiority is an appropriate design to compare invasive and non-invasive procedures when the invasive treatment is the standard of care.
⇒ Prospective randomisation ensures equal treatment groups which reduces the risk of selection and allocation bias.
⇒ The outcome measures include both patient subjective outcomes and objective clinical and radiographic outcomes.
⇒ Defining a precise non-inferiority margin that may be accepted by clinicians has been a challenge.
⇒ Blinding of study participants is not possible due to the nature of interventions.

INTRODUCTION

Ankle fractures are the most common injuries treated operatively by orthopaedic surgeons, and the incidence is increasing.[1] Isolated fibular fractures comprise around 70% of ankle fractures[2] and are classified as infrasyndesmotic, transsyndesmotic or suprasyndesmotic, depending on the location of the fracture relative to the syndesmotic ligaments.[3] Infrasyndesmotic fractures are traditionally treated non-operatively, and an increasing number of transsyndesmotic fractures are also treated non-operatively with excellent results and without the burden of complications that accompany surgery.[2 4 5] Trans-syndesmotic fractures are classified as either stable or unstable depending on the medial clear space during a stress test,[1 2] and it is now widely accepted that stable fractures should be treated non-operatively.[1 2 4–6]

Suprasyndesmotic fractures are historically treated operatively because of the assumption that the distal tibiofibular syndesmosis is ruptured, leading to joint instability.[7 8] Instability of the distal tibiofibular syndesmosis may lead to pain, poor function and early osteoarthritis (OA). Therefore, these

fractures are treated, according to most guidelines, with anatomic reduction, rigid fixation of the lateral malleolus and some type of syndesmotic stabilisation.[9] According to the same guidelines, postoperative full weightbearing with a cast is advised unless a syndesmotic position screw is used.[9] Recent studies have shown that the medial deltoid ligament functions as the main stabiliser of the ankle joint by preventing external rotation of the talus and therefore maintains the dynamic congruity.[6] Boden *et al* demonstrated in a cadaver study that the damage to the distal tibiofibular syndesmosis did not yield instability as long as the deltoid ligament was intact.[7] This is also demonstrated clinically in a number of studies,[1 6 10–12] concluding that isolated syndesmotic injuries with an intact deltoid ligament can be managed conservatively.[10] According to the Lauge-Hansen classification, suprasyndesmotic fractures occur in pronation-type injuries,[8] which dictate damage to the deltoid ligament, but studies have shown that suprasyndesmotic fractures may also occur in injury mechanisms with preserved medial attachments.[12]

Weightbearing radiographs have shown to be a promising stress test to evaluate ankle stability in transsyndesmotic fractures, but have rarely been used on suprasyndesmotic fractures. Our aim is to compare the efficacy of operative and non-operative treatment of patients with suprasyndesmotic ankle fractures that reduce on weightbearing radiographs.

METHODS AND ANALYSIS

Study design

The study will be conducted as a prospective, multicentre, non-inferiority, randomised controlled trial, 1:1 parallel group study, comparing operative versus non-operative treatment of suprasyndesmotic ankle fractures. The planned follow-up time is 2 years, with the possibility of prolonging follow-up to 5 and 10 years. The protocol is developed in adherence with the Standard Protocol Items: Recommendations for Interventional Trials statement.[13] Inclusion started in December 2020.

Participants

Patients aged 18–70 years presenting with a closed, isolated fibular fracture classified as suprasyndesmotic with a medial clear space of less than 7 mm in mortise view on initial non-weightbearing radiographs and less than 14 days after injury will be considered for study eligibility.

Eligible patients will have a weightbearing (at least 50% of body weight) standing radiograph for the evaluation of the stability of the fracture.[14] Patients with a congruent ankle mortise (ie, stable fracture) on weightbearing radiographs will be randomised to either operative (reference treatment) or non-operative treatment. The orthopaedic surgeon responsible for inclusion will define the ankle joint as congruent if the medial clear space is similar to the superior clear space. Randomisation will be performed using the web-based solution WebCRF Collecting Clinical Data (https://webcrf.medisin.ntnu.no/client/index.php), which is hosted by the Norwegian University of Science and Technology. The allocation schedule will be concealed from people involved in the recruitment of participants and from potential participants. Randomisation will be stratified by fracture type (Maisonneuve fracture (fracture of the proximal third of the fibula[15]) or not) and age (<60 years or ≥60 years).

Patients with an incongruent ankle mortise (ie, unstable fracture) will be treated operatively according to the current clinical practice and included in a parallel observational cohort study. Patients who are unwilling to participate in the intervention study are also invited to participate in the observational cohort study.

Eligibility criteria

Inclusion criteria

- Age 18–70 years
- Isolated fibular fractures classified as suprasyndesmotic
- Medial clear space of <7 mm in mortise view on primary radiographs
- <14 days since the injury

Exclusion criteria

- Previous fractures or surgically treated ligamentous injury to the injured ankle
- Pathological fracture
- Diabetic neuropathy or other neuropathies
- Drug abuse
- Inability to consent and/or comply
- Inability to understand the Norwegian language
- Inability to walk unaided prior to the fracture
- Concomitant tibial fracture requiring surgical treatment (patients with undisplaced or minimally displaced concomitant tibial fractures can be included if they do not require surgical treatment)
- Patients from outside the catchment area of the recruiting hospitals unable to undergo follow-up visits at one of the recruiting hospitals

Surgical intervention

Patients randomised to operative treatment will have their surgery performed by an orthopaedic surgeon or by orthopaedic trainees under the supervision of a consultant, when fit for surgery. The surgical technique and choice of implants will be decided by the surgeon to resemble clinical practice. The syndesmosis must be reduced (closed or open) and fixed. Postoperatively, the patients will be treated with an Aircast ankle orthosis or similar orthotic device for 6 weeks with weightbearing as tolerated. Other types of casts can be used if preferred by the treating orthopaedic surgeon, but the cast must allow full weightbearing and must prevent equinus position.

The first follow-up visit with an independent observer takes place 2 weeks postoperatively for clinical assessment and radiographs. At the next follow-up visit with an independent observer 6 weeks postoperatively, radiographs are obtained, the Aircast is removed and full weightbearing continued.

Non-operative intervention

Patients randomised to non-operative treatment are treated with an Aircast ankle orthosis or similar orthotic device for 6 weeks with weightbearing as tolerated. Other types of casts can be used if preferred by the treating orthopaedic surgeon, but the cast must allow full weightbearing and must prevent equinus position.

The first follow-up visit with an independent observer takes place 2 weeks postoperatively for clinical assessment and radiographs. At the next follow-up visit with an independent observer 6 weeks postoperatively, radiographs are obtained, the Aircast is removed and full weightbearing is continued.

Outcome measures and follow-up

Outcome definitions

Patient-reported outcomes are collected as a questionnaire prior to the clinical examination (registration of the range of motion) performed by an independent observer. The questionnaire is answered at 2 weeks, 6 weeks, 3 months and 2 years after the injury. In addition, ankle radiographs including mortise, anteroposterior and lateral views will be conducted at each visit. A CT scan will be conducted at the 24-month follow-up (figure 1).

Primary outcome measure

The primary outcome measure is the Olerud-Molander Ankle Score (OMAS), which is a condition-specific, patient-reported measure of ankle-fracture symptoms that is validated in Norway.[16 17] The OMAS scale ranges from 0 to 100, with higher scores indicating better outcomes and fewer symptoms.

Non-inferiority of non-operative treatment is claimed if the lower bound of the one-sided 95% CI of the treatment effect at 24-month follow-up exceeds 10 points on OMAS.

Secondary outcome measures

Ankle pain

Ankle pain is measured by the Numeric Rating Scale), which is an 11-point numeric scale ranging from 0 ('no pain') to 10 ('worst pain imaginable').[18]

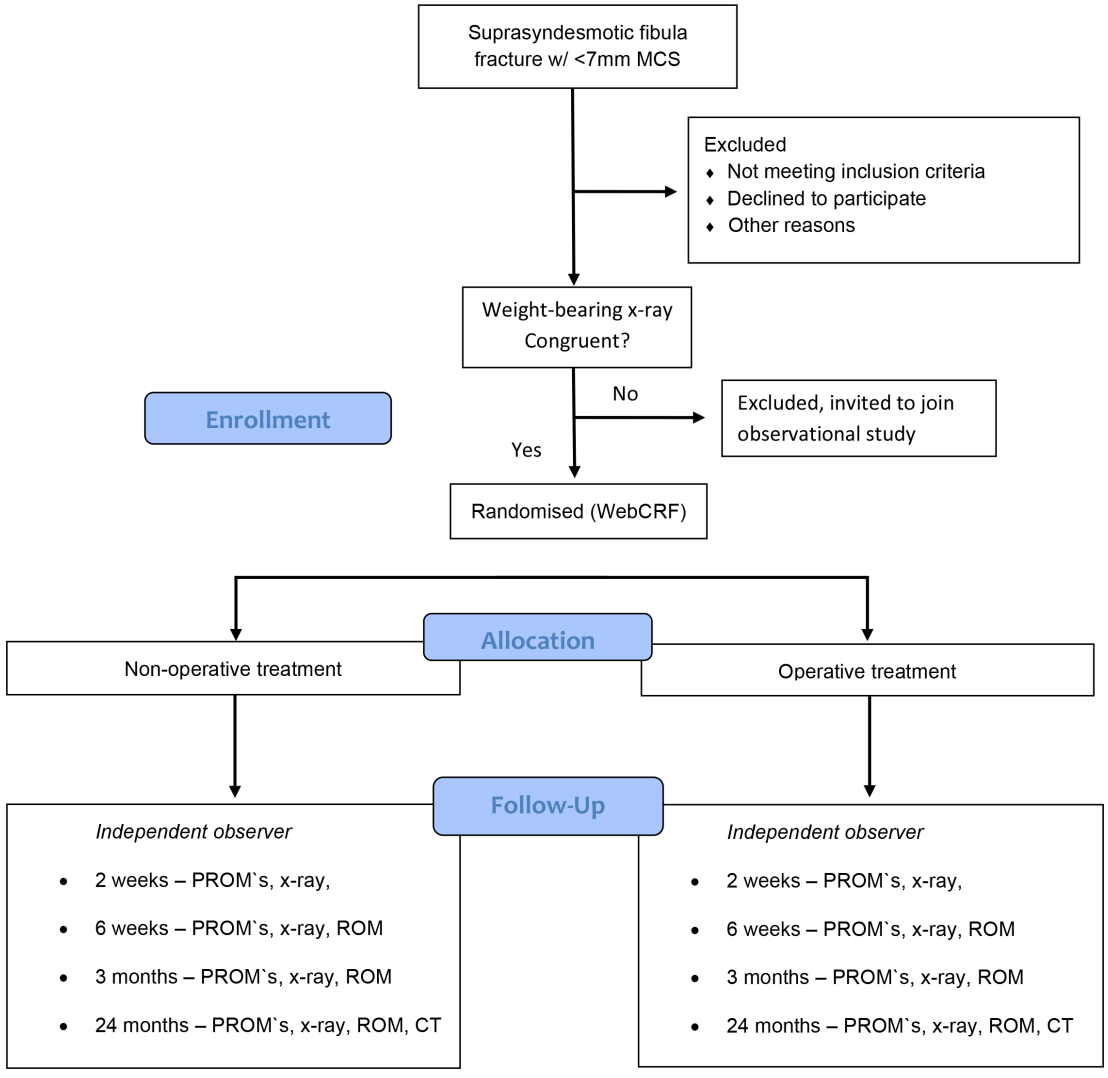

Figure 1 Study flow chart. MCS, medial clear space; PROM, patient reported outcome measure; ROM, range of motion.

Ankle-related symptoms

Ankle-related symptoms are, in addition to the OMAS questionnaire, measured by the Manchester-Oxford Foot Questionnaire (MoxFQ).[19] The MoxFQ is a 16-item questionnaire consisting of three subscales: walking/standing problems (seven items), pain (five items) and issues related to social interaction (four items). Patients score each question on a five-point Likert scale ranging from 0 to 4, with 4 representing the worst stage. Raw scores are converted to a numeric scale ranging from 0 to 100, with 100 denoting the most severe symptoms.

Quality of life

Quality of life is measured by the EuroQol 5-Dimension (EQ-5D) questionnaire.[20] EQ-5D is a validated generic health-related quality-of-life instrument. It consists of two parts: EQ-5D descriptive part and EQ-5D visual analogue scale (VAS). The descriptive part includes five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression), each with five possible answers. EQ-5D VAS is a visual analogue scale of self-related overall health, ranging from 0 (worst imaginable health state) to 100 (best imaginable health state).

Radiographic results

Radiographic results (fracture healing, joint congruency, syndesmotic reduction and post-traumatic OA) are assessed by plain radiographs and CT. Post-traumatic OA is graded on radiographs according to van Dijk *et al*.[21] All study radiographs are collected and evaluated by an independent consultant radiologist.

Range of motion

Range of motion of both ankles will be assessed after 6 weeks, 3 months and 24 months by a physiotherapist or surgeon not involved in the study, using a goniometer to measure active loaded dorsiflexion and plantar flexion.

Adverse events

Adverse events including deep vein thrombosis, nerve injury, wound infection and other complications occurring during the 24 months of follow-up are registered. Reoperations and crossover from non-operative to operative treatment are also registered.

Sample-size calculation and statistical methods

Sample-size calculations

Based on previous studies of suprasyndesmotic fractures, we anticipate the distribution of OMAS to have a mean of 90 points and SD of 20 points in both treatment groups at the end of follow-up (ie, 24 months after the start of treatment).[22 23] A minimal clinically important difference (MCID) in OMAS has been estimated as 11.5 points at 1-year follow-up of patients treated surgically for unstable ankle fractures.[24] In the present study, we have chosen a more conservative non-inferiority margin of 10 points for OMAS. This corresponds to the largest clinically acceptable difference in mean OMAS between operative and non-operative treatment for non-operative treatment to be regarded as at least as good as operative treatment with respect to ankle-fracture symptoms.

With a statistical power of 80%, a one-sided significance level of 5% and a non-inferiority margin of 10 points for the difference in mean OMAS between the two treatment groups at 2-year follow-up, 50 patients are required in each group. When adding 20% for possible dropouts, the total number of patients required in this study is 120.

Statistical methods

Statistical analyses will be performed by using IBM SPSS Statistics or similar statistical software. A Consolidated Standards of Reporting Trials (CONSORT) chart illustrating participant flow throughout the study will also be produced.

A significance level of 5% will be used throughout all statistical analyses. The 95% CIs will be reported.

Adherence, protocol deviations and analysis populations

According to intention-to-treat (ITT) principles, patients who change treatment group (crossover) and other patients who are not treated according to protocol will be included in the analysis and kept in the treatment group to which they were initially allocated. Patients may be subject to crossover at each follow-up point.

In addition, a per-protocol (PP) analysis, including only the patients who have been treated and followed up according to the study protocol, will be conducted for the primary outcome variable.

The ITT population includes all randomised patients, regardless of protocol adherence, whereas the PP population is restricted to patients who have followed the protocol (ie, received the allocated treatment and attended all scheduled follow-up visits).

The primary analysis will be based on the ITT population.

Analysis methods

Separate linear mixed-effects regression models will be fitted to assess the effect of non-operative versus operative treatment on each of the patient-reported measures (function, pain and quality of life) and range of motion, using all available measurements.

Terms of interaction between treatment and follow-up time will be included to allow for different treatment effects during follow-up, where the 24-month treatment effect is the main endpoint.

In order to account for the dependence in the data due to repeated measurements, a random intercept for each subject will be included in the regression models.

Safety analyses will involve descriptive statistics and tabulations of adverse events in each treatment group.

The regression models will be adjusted for treating unit in addition to the two dichotomous variables for fracture type and age used in the stratified randomisation.

The trial will be underpowered for subgroup analyses, but we may perform exploratory analyses on age and fracture type according to the stratification at randomisation.

Blinding

Blinding of participants is not possible due to the nature of the interventions. Blinding of site investigators and clinical staff at follow-up is challenging due to the nature of the interventions and is therefore not done. The use of an independent observer at each follow-up point was implemented to limit bias.

Statistical interim analysis and stopping guidance

No statistical interim analysis is planned, but regular scientific board meetings are organised in order to evaluate the safety of the study. The sites are instructed to immediately report cases of lack of tibiotalar congruency and other symptomatic malunions at follow-up and any unplanned surgery.

Patients and public involvement

A patient expert was recruited through the National Association for the Traumatically Injured (Personskadeforbundet LTN) and was invited to attend research group meetings in order to enhance the users' perspective of the conduction of the study, including the selection of outcome measures.

Publication details will be disseminated to study participants who express an interest.

Ethics and dissemination

The study is approved by the Regional Committee for Medical and Health Research South East, group A (ref 169307). Participants must sign a written informed consent form before being randomised into the study. Participants will be informed, written and orally, that participation in the study is voluntary and that they can withdraw their consent at any time without it influencing further treatment. The project is in accordance with the Helsinki Declaration. All data collection and management will agree with the terms in approvals.

DISCUSSION

Research on suprasyndesmotic fractures has mainly focused on operative technique and implant choice. Due to the assumptive unstable nature of these fractures, non-operative treatment has not been considered as an alternative and has therefore not been adequately studied. As stress testing has evolved and now aids in guiding the treatment of different types of ankle fractures, we aim to explore if equivalent principles could apply to suprasyndesmotic fractures.

The exact proportions of stable and unstable suprasyndesmotic fractures is largely unknown, and we have also aim to explore the differences between these fractures. Therefore, patients with unstable suprasyndesmotic fractures are invited to participate in a parallel observational study after surgical treatment.

Non-inferiority trials seek to determine whether a new treatment is no worse than a reference treatment by more than an acceptable margin. The new treatment should have an advantage over the reference treatment and does therefore not need to show superior results in order to be implemented. In our trial, we evaluate whether non-operative treatment of suprasyndesmotic ankle fractures is non-inferior to operative treatment. Non-operative treatment has the obvious advantage of avoiding hospitalisation and potential complications from operative treatment. Other potential advantages of non-operative treatment could be a quicker return to daily activities, less pain and lower socioeconomic costs. The difference between the new treatment and reference treatment should not be larger than a predefined margin of non-inferiority in order to prove non-inferiority of the new treatment. When agreeing on an acceptable non-inferiority margin, the CONSORT guidelines state that it should be specified and preferably justified on clinical grounds. For our primary outcome (OMAS), previous studies have estimated MCID of 11.5 points.[24] During the planning of this study, several experienced trauma surgeons participated in a group discussion and concluded that the non-inferiority margin should be lower in order for the results to be acceptable in their daily clinical practice. The group agreed on 10 points as the non-inferiority margin. Certain physicians may argue that 10 points is still too high and increases the risk of accepting a truly inferior treatment as non-inferior, but as we have chosen a number below a previously estimated MCID, we consider this decision justified.

The predominating surgical management of suprasyndesmotic fractures has been justified by the assumption that their inherent instability will eventually result in post-traumatic OA. We acknowledge the concern for the patients in the non-operative group, but with the increasing evidence supporting weightbearing radiographs as a method of evaluating the patency of the deltoid ligament and thus the stability of the ankle mortise, we are convinced that the rationale behind the present study is justified.[25–31] Recent studies on weightbearing radiographs of transsyndesmotic fibula fractures have shown that the ankle congruency is preserved after fracture union, and we expect the same results for suprasyndesmotic fractures.[32] We also plan to prolong the follow-up period to 5 and 10 years in order to identify possible later presentations of post-traumatic OA.

Contributors OS, MR, FF, WF, JEM, MM and HF contributed to the conception and design of the study. All authors contributed to the writing of the manuscript, provided critical revision and approved the final version of the manuscript. OS and HF guarantee the integrity of the work.

Funding This work was supported by South-Eastern Norway Regional Health Authority and Innlandet Hospital Trust (grant number 150462).

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

ORCID iD
Ola Saatvedt http://orcid.org/0009-0009-8638-9195

REFERENCES

1 Michelson JD. Fractures about the ankle. *J Bone Joint Surg Am* 1995;77:142–52.
2 Gougoulias N, Sakellariou A. When is a simple fracture of the lateral malleolus not so simple? How to assess stability, which ones to fix and the role of the deltoid ligament. *Bone Joint J* 2017;99-B:851–5.
3 Meinberg EG, Agel J, Roberts CS, *et al*. Fracture and dislocation classification compendium-2018. *J Orthop Trauma* 2018;32 Suppl 1:S1–170.
4 Mittal R, Harris IA, Adie S, *et al*. Surgery for type B ankle fracture treatment: a combined randomised and observational study (CROSSBAT). *BMJ Open* 2017;7:e013298.
5 Bauer M, Jonsson K, Nilsson B. Thirty-year follow-up of ankle fractures. *Acta Orthop Scand* 1985;56:103–6.
6 Michelson JD, Magid D, McHale K. Clinical utility of a stability-based ankle fracture classification system. *J Orthop Trauma* 2007;21:307–15.
7 Boden SD, Labropoulos PA, McCowin P, *et al*. Mechanical considerations for the syndesmosis screw. A cadaver study. *J Bone Joint Surg Am* 1989;71:1548–55.
8 Lauge-Hansen N. Fractures of the ankle. II. Combined experimental-surgical and experimental-roentgenologic investigations. *Arch Surg* 1950;60:957–85.
9 Barbosa P, Bonnaire F, Kojima K. AO surgery Referance. 2015. Available: https://surgeryreference.aofoundation.org/orthopedic-trauma/adult-trauma/malleoli/suprasyndesmotic-simple-fibular-fracture-medial-injury-posterior-fracture [Accessed 20 Mar 2023].
10 van Dijk CN, Longo UG, Loppini M, *et al*. Conservative and surgical management of acute isolated Syndesmotic injuries: ESSKA-AFAS consensus and guidelines. *Knee Surg Sports Traumatol Arthrosc* 2016;24:1217–27.
11 Fox A, Wykes P, Eccles K, *et al*. Five years of ankle fractures grouped by stability. *Injury* 2005;36:836–41.
12 Ebraheim NA, Mekhail AO, Gargasz SS. Ankle fractures involving the fibula proximal to the distal tibiofibular syndesmosis. *Foot Ankle Int* 1997;18:513–21.
13 Chan A-W, Tetzlaff JM, Altman DG, *et al*. SPIRIT 2013 statement: defining standard protocol items for clinical trials. *Ann Intern Med* 2013;158:200–7.
14 Yousaf S, Saleh A, Ahluwalia A, *et al*. Systematic review of stress radiographic modalities stability assessment in supination external rotation ankle fractures. *Foot Ankle Orthop* 2019;4:2473011419890861.
15 Kalyani BS, Roberts CS, Giannoudis PV. The Maisonneuve injury: a comprehensive review. *Orthopedics* 2010;33:196–7.
16 Garratt AM, Naumann MG, Sigurdsen U, *et al*. Evaluation of three patient reported outcome measures following operative fixation of closed ankle fractures. *BMC Musculoskelet Disord* 2018;19:134.
17 Olerud C, Molander H. A scoring scale for symptom evaluation after ankle fracture. *Arch Orthop Trauma Surg (1978)* 1984;103:190–4.
18 Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. *J Clin Nurs* 2005;14:798–804.
19 Dawson J, Boller I, Doll H, *et al*. The MOXFQ patient-reported questionnaire: assessment of data quality, reliability and validity in relation to foot and ankle surgery. *Foot (Edinb)* 2011;21:92–102.
20 Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol group. *Ann Med* 2001;33:337–43.
21 van Dijk CN, Verhagen RA, Tol JL. Arthroscopy for problems after ankle fracture. *J Bone Joint Surg Br* 1997;79:280–4.
22 Laflamme M, Belzile EL, Bédard L, *et al*. A prospective randomized multicenter trial comparing clinical outcomes of patients treated surgically with a static or dynamic implant for acute ankle syndesmosis rupture. *J Orthop Trauma* 2015;29:216–23.
23 Wikerøy AKB, Høiness PR, Andreassen GS, *et al*. No difference in functional and radiographic results 8.4 years after quadricortical compared with tricortical syndesmosis fixation in ankle fractures. *J Orthop Trauma* 2010;24:17–23.
24 Gausden EB, Levack A, Nwachukwu BU, *et al*. Computerized adaptive testing for patient reported outcomes in ankle fracture surgery. *Foot Ankle Int* 2018;39:1192–8.
25 Aiyer AA, Zachwieja EC, Lawrie CM, *et al*. Management of isolated lateral malleolus fractures. *J Am Acad Orthop Surg* 2019;27:50–9.
26 British Orthopaedic Association. British Orthopaedic Association standards for trauma: the management of ankle fractures. Available: https://www.boa.ac.uk/uploads/assets/f8b1c499-c38a-4805-8cb8d8eb3087bca7/8be763eb-5921-4cb2- b6802f3e65ce8e7f/the%20management%20of%20ankle%20 fractures.pdf [Accessed 04 Mar 2021].
27 Dawe EJC, Shafafy R, Quayle J, *et al*. The effect of different methods of stability assessment on fixation rate and complications in supination external rotation (SER) 2/4 ankle fractures. *Foot Ankle Surg* 2015;21:86–90.
28 Holmes JR, Acker WB, Murphy JM, *et al*. A novel algorithm for isolated Weber B ankle fractures: a retrospective review of 51 nonsurgically treated patients. *J Am Acad Orthop Surg* 2016;24:645–52.
29 Hoshino CM, Nomoto EK, Norheim EP, *et al*. Correlation of weightbearing radiographs and stability of stress positive ankle fractures. *Foot Ankle Int* 2012;33:92–8.
30 Seidel A, Krause F, Weber M. Weightbearing vs gravity stress radiographs for stability evaluation of supinationexternal rotation fractures of the ankle *Foot Ankle Int* 2017;38:1402.
31 Weber M, Burmeister H, Flueckiger G, *et al*. The use of weightbearing radiographs to assess the stability of supination-external rotation fractures of the ankle. *Arch Orthop Trauma Surg* 2010;130:693–8.
32 Gregersen MG, Molund M. Weightbearing radiographs reliably predict normal ankle congruency in Weber B/Ser2 and 4A fractures. A prospective case-control study. *Foot Ankle Int* 2021;42:1097–105.