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Ankle Fractures: An Expert Survey of Orthopaedic Trauma Association (OTA) Members and Evidence-Based Treatment Recommendations

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Abstract

Objectives: The goal of this study was to describe current practice patterns of orthopaedic trauma experts regarding the management of ankle fractures, to review the current literature, and to provide recommendations for care based on a standardized grading system.

Design: Web-based survey

Participants: Orthopaedic Trauma Association (OTA) members

Methods: A 27-item web-based questionnaire was advertised to members of the OTA. Using a cross-sectional survey study design, we evaluated the preferences in diagnosis and treatment of ankle fractures.

Results: One hundred and sixty-six of 1967 OTA members (8.4%) completed the survey (16% of active members). There is considerable variability in the preferred method of diagnosis and treatment of ankle fractures among the members surveyed. The majority of responses are in keeping with best evidence available.

Conclusions: Current controversy remains in the management of ankle fractures. This is reflected in the treatment preferences of the OTA members who responded to this survey.

Level of Evidence: Therapeutic Level V. See Instructions for Authors for a complete description of levels of evidence.

Keywords: ankle fracture; syndesmosis; OTA; Orthopaedic Trauma Association; EBQVS; expert; opinion; survey

Introduction:

Ankle fractures remain one of the most common fractures treated by Orthopaedic surgeons in both academic and community practice. Despite being "just another ankle fracture" these injuries can pose treatment challenges, and continue to be a source of controversy as to the best method of treatment. Research is ongoing in this field, and remains a popular topic at the Orthopaedic Trauma Association (OTA) annual meeting[1]. The purpose of this project was to survey active members of the OTA regarding diagnosis and treatment of ankle fractures and review current best evidence to guide treatment decisions.

Methods:

A 27-item web-based close-ended questionnaire was developed by the OTA Evidence-Based Quality Value and Safety Committee using a modified Delphi process (see Appendix, Supplemental Digital Content 1, http://links.lww.com/JOT/A711). All OTA members received a link to the survey via email with a solicitation to participate. This request was made within the normal activities of the organization and collected no sensitive information with the entry into the survey constituting implied consent; therefore, no IRB review was required. Survey responses were collected using the REDCap system, a free and secure web-based data entry system, during an 11-month period (October 1, 2016 to August 30, 2017) and stored in a de-identified and secure fashion. Results were compiled, and are presented as the percentage of respondents.

Each recommendation was graded using articles that were considered by the committee as "the best available evidence" using the grading system adopted and endorsed by the American Academy of Orthopedic Surgeons' Evidence-based Quality and Value (EBQV) committee as follows:[2]

1. Strong: Greater than 2 high-quality (level I) studies to support the recommendation.
2. Moderate: One high (level I) or 2 moderate quality (level II or III) studies to support the recommendation.
3. Limited: One moderate (level II or III) or 2 low-quality (Level IV) studies to support the recommendation.
4. Consensus: Expert work-group opinion (no studies).

Results:

One hundred and sixty-six of 675 (8.4%) OTA members responded to the survey. This represents 15.6% (97/619) active OTA members, in keeping with response rates of previously published OTA surveys.[3,4] Not every question was answered by each respondent. The number of years in practice among respondents included: 0 to 5 years: 30%, 6 to 10 years: 22%, 11 to 15 years: 12%, 16 to 20 years: 8%, and >20 years: 28%. Ninety-three percent reported taking trauma call at their institution, and 88% noted fellowship training in orthopaedic trauma. Over 85% of respondents reported dedicating more than half of their clinical practice to trauma care. Sixty-five percent noted practice in an academic or university setting, and 35% self-identified as practicing in the community. Only 31% reported being in private practice, 45% of respondents are affiliated with an academic institution or university, and the remainder being employed

by a hospital or Health Maintenance Organization. Over 75% of respondents reported treating more than 25 ankle fractures operatively per year. Complete survey results may be found in an Appendix (see Supplemental Digital Content 2, http://links.lww.com/JOT/A712).

Discussion:

The management of lateral malleolus fractures is based on ankle stability.[5] Stable fractures may be successfully managed with non-operative treatment, while unstable fractures benefit from surgical stabilization.[5] Determining which fractures are unstable and would therefore benefit from surgery remains the treatment dilemma. Physical examination, particularly assessing medial ankle tenderness has been shown to be unreliable.[6] Fracture classification systems, based on static radiographs, do not accurately predict fracture instability.[7] Advanced imaging studies such as MRI have also proven ineffective in determining fracture stability.[8] In order to determine the stability of the ankle, some type of dynamic stress radiograph is required. This can be in the form of an external rotation stress radiograph,[9] gravity stress radiograph,[10] or weight-bearing radiograph.[10] Studies comparing the external rotation and gravity stress radiographs have shown equivalent results, [12-14] with the gravity stress radiograph potentially causing less discomfort for patients.[14] Another potential advantage of the gravity stress radiograph is that no physician presence or radiation exposure to medical personnel is required.[12] The gravity stress radiograph, however, is not performed with the ankle in neutral dorsiflexion, and may therefore give a higher false-positive rate.[12] Proponents of weight-bearing radiographs suggest that both

external rotation and gravity stress radiographs may overestimate instability, leading to unnecessary surgery and potential complications.[15,16] In the OTA member survey, only 59% of the respondents utilize one of these dynamic stability tests, meaning 41% are potentially under-recognizing, and perhaps under-treating unstable injuries. However, not all stress-positive ankle fractures require surgery, and some may be successfully managed with immobilization or bracing.[17,18] Of those respondents who tested ankle stability (n=96), 49% preferred manual external rotation stress radiographs, 36% preferred gravity stress radiographs, and 15% preferred standing weight-bearing radiographs during treatment.

Regarding fixation of unstable fibula fractures, 58% of respondents prefer lateral plating, and 42% prefer posterolateral plating. The use of a posterolateral plate in an anti-glide position has biomechanical advantages over a lateral plate[19] and even a lateral locking plate[20]. Despite this biomechanical advantage, no clinically relevant advantage has been demonstrated of one plating position over the other.[21-23] Lateral plates may have more superficial prominence, while posterolateral plates may cause irritation of the peroneal tendons, although the reported rate is low.[21,24] Although studies have demonstrated equal or better results with intramedullary nailing of fibula fractures,[25,26] this technique was not preferred by any of the respondents.

Following fixation of an OTA/AO[27] 44B fracture, 99% of respondents indicated that they would then proceed with stress examination of the syndesmosis, recognizing the importance, and common occurrence, of an associated syndesmosis injury.[28,29] Either

a hook (Cotton) test or external rotation stress test may be used.[30] Instability of the syndesmosis following fixation of the fibula has been reported to range from 17 to 39% in the literature,[28-30] which is consistent with the experience of the respondents.

There is significant variability in the aftercare of surgically treated ankle fractures.[31,32] While several studies have advocated for early weight-bearing and mobilization following fixation of ankle fractures,[33-35] others have shown little improvement or even increased complications.[36,37] The most recent Cochrane systematic review in 2012 concluded that there was "limited evidence" supporting early commencement of weight-bearing and the use of removable immobilization.[38] A more recent randomized controlled trial showed improved early function and lower incidence of hardware removal with early range-of-motion and early weight-bearing in patients without posterior malleolar fractures or syndesmotic injuries.[39] Further research on this topic is ongoing.[40] When presented with the scenario of a 50 year-old male with a bimalleolar ankle fracture treated with stable internal fixation, only 35% of respondents chose to initiate weight-bearing prior to 6 weeks. Seventy-eight percent of respondents permitted the use of a removable orthosis following suture removal. Despite reasonable support for the safety of early weight-bearing of surgically stabilized ankle fractures, survey respondents continue to prefer a more protective approach. Careful patient selection may be important if early weight-bearing and mobilization are to be successfully employed.

There is likely no topic related to the management of ankle fractures that remains more controversial than the management of syndesmosis injuries. Most authors agree that the quality of syndesmosis reduction is critical to patient outcome.[41-43] Intraoperative assessment of the adequacy of syndesmosis reduction remains challenging. Fluoroscopic measurements used to assess the quality of indirect reduction have typically included tibiofibular clear space, tibiofibular overlap, and medial clear space.[44] There is considerable anatomic variability of the syndesmosis and the radiographic relationship between the tibia and fibula.[45-47] Contralateral ankle comparison radiographs may be helpful in determining patient-specific norms. More recently, use of the contralateral ankle lateral radiograph has been advocated for assessing sagittal plane reduction,[48] however, even assessment of reduction using these images remains challenging.[49] Additionally, rotational malreduction may be present, which can be difficult to assess fluoroscopically.[50] In this survey, 58% of respondents rely on fluoroscopy alone to assess the adequacy of syndesmosis reduction. Despite the body of evidence showing the utility of contralateral comparison radiographs, only 54% of these respondents are using these control radiographs. Even with the use of these indirect fluoroscopic assessments, malreductions are likely to continue to occur, until more effective methods are developed.[51,52]

As an alternative to indirect reduction and fluoroscopic assessment of syndesmosis reduction, direct open visualization and reduction of the syndesmosis has been advocated.[53,54] This is the preferred method of reduction assessment alone in 7% of respondents, and is combined with fluoroscopic techniques by an additional 35%.

Despite the use of an open reduction technique, syndesmosis malreduction still occurs in a surprisingly high number of cases.[55] The use of 3-dimensional intraoperative fluoroscopy has been advocated by some authors to improve the assessment of reduction, but still has not proven to be the solution.[55,56] Ultimately, routine use of post-operative CT scans may be the only accurate means of assessing the final reduction.[57] Recent studies have not shown a correlation between minor syndesmotic malreduction and clinical outcomes, suggesting prior criteria used for assessment of reduction may be excessively stringent for the clinical setting.[52,58]

Once the syndesmosis is reduced, the choice of fixation also remains controversial. The majority of survey respondents prefer to use two 3.5mm screws over the use of a single 3.5mm screw, and a much smaller number prefer 4.5mm screws. Biomechanically, it is not surprising that the larger diameter screw better resists shear,[59] however, cadaveric studies looking at syndesmosis widening and torsional loads have failed to show an advantage of the larger screws.[60,61] Larger diameter screws have been shown to have a lower rate of breakage and loosening clinically,[62] however, as there is normally some physiologic motion between the tibia and fibula,[63] more rigid fixation may not be desirable. No clinically significant advantage has been demonstrated. Similarly, although biomechanically two screws are stronger than one,[64] no clinically significant advantage has been demonstrated. Tricortical or quadricortical screw placement has also been the subject of much debate. Both biomechanical[61,65] and clinical studies[62,66-68] have shown no significant advantage of one technique over the other. Based on the

current evidence, choice of screw size and number as well as number of cortices engaged remains at the discretion of the treating surgeon.

If syndesmotic screw fixation is used, debate also remains as to whether the screws should be removed or not, and if so, when. Over time, with weight-bearing and mobilization, screws may either remain stable, loosen, or break. Nineteen percent of survey respondents indicated that they always remove syndesmosis screws as part of their standard of care. While one study showed benefit to screw removal in some patients,[69] several systematic reviews of multiple studies looking at syndesmotic fixation have shown no advantage of routine screw removal over retention.[70-72] Concern for performing early screw removal prior to screw breakage does not seem to be warranted, as some of the best clinical results are seen in patients with broken screws.[69,73] Premature screw removal may lead to recurrence of syndesmosis diastasis, and should not be performed prior to 8 weeks, and should likely be delayed even longer.[68,74] More recent literature has suggested that syndesmotic screw removal may allow the syndesmosis to return to a more normal position, particularly following syndesmosis malreduction.[75,76] Selective screw removal in patients with intact hardware and ongoing symptoms seems a logical approach. This is reflected in the results of this survey, where 72% of respondents remove syndesmotic screws only when the patient has ongoing pain or stiffness, or by patient request. Further study to perhaps better elucidate the ideal candidate for, and timing of, screw removal is ongoing.[77]

As an alternative to screw fixation of the syndesmosis, there has been significant recent interest in flexible fixation of the syndesmosis using a suture-button device. The proposed benefit is more flexible and perhaps "physiologic" movement of the fibula, obviating the need for hardware removal. While biomechanically not restoring normal stability of intact syndesmotic ligaments, and not providing as much stability as screw fixation, a suture-button may still provide sufficient stability to the syndesmosis for healing clinically.[78,79] Randomized trials comparing suture-button to screw fixation have shown equivalent or even improved results with the suture-button device,[80-82] and a recent meta-analysis has shown no difference in functional outcome or complications, but perhaps a quicker return to work with the suture-button device.[83] Reduction of the syndesmosis may even be improved with the use of this device over conventional screw fixation.[84] The cost of the suture-button device remains a concern. When the potential cost-savings of avoiding future screw removal is considered, the use of this new device may become cost-effective.[85] An additional concern is that this device has not been studied in situations where fibular length must be maintained by the fixation, and care should be taken in this scenario. At this time, only 17% of survey respondents are using a suture-button device for syndesmotic injuries.

Fixation of the posterior malleolus also remains a controversial topic. Involvement of the posterior malleolus in ankle fractures has been associated with worse clinical outcomes than in fractures which do not involve the posterior malleolus.[86-88] Determination of the size of the posterior malleolar fragment on the lateral image can be challenging, and the size of the fragment is best determined on an external rotation lateral radiograph[89]

or CT scan.[90] Larger fragment size had been associated with worse outcomes by some authors,[91,92] An early biomechanical study suggested posterior fracture fragments ≥25% of the articular surface led to posterior talar translation,[93] while another study showed no increase in translation with fragments ≤40%.[94] As more ligamentous structures about the ankle are disrupted, the role of the posterior malleolus in ankle stability likely becomes more important, as no posterior translation has been shown with fragments ≤40% unless the lateral side of the ankle is unstable.[95] The posterior malleolus fragment is the site of attachment of the posterior inferior tibiofibular ligament, and may impact the stability of the syndesmosis.[96] Fixation of the posterior malleolus may be sufficient to restore syndesmosis stability.[97] While some authors have used a fragment size of ≥25% as an indication for surgery,[94] others have advocated for fixation of fragments larger than 10%.[98] At this time there is no consensus in the literature as to the absolute size of the posterior malleolus fragment that needs to be fixed, and there are likely other factors that need to be taken into consideration during decision making.[99] This is reflected in the results of the current survey, where 10% of respondents fix all fragments regardless of size, 31% use fragment size ≥10% as an indication for surgery, and 55% have a threshold of ≥25%. If the decision is made to fix the posterior malleolus, multiple studies have shown that posterior plate fixation is superior to lag screws alone, either from posterior to anterior, and even more so anterior to posterior.[100-102] Open reduction and internal fixation with a posterolateral plate was the preferred method of fixation in 75% of respondents in this study. Fifteen percent are still using percutaneous anterior to posterior lag screws.

Finally, for the ultimate in controversy, we asked about venous thromboembolism (VTE) prophylaxis. Symptomatic VTE is a known complication of operatively treated ankle fractures, with a described incidence of 3.6% in one large observational study.[101] Even non-operatively managed ankle fractures were shown to have a pulmonary embolism incidence of 0.22% in a large database study of over 14,000 patients.[102] Despite this known incidence of symptomatic VTE, the evidence for routine prophylaxis is lacking. Several randomized controlled trials have failed to show any benefit to routine prophylaxis.[103-107] These studies were likely underpowered due to the low incidence of VTE. The most recent recommendation of the American College of Chest Physicians (2012) recommends against the routine prophylaxis of patients with isolated lower-extremity injury requiring immobilization.[108] This position is also supported by the most recent consensus statement from the American College of Foot and Ankle Surgeons.[109] More recent recommendations suggest the use of risk-stratification in an effort to target high-risk patients.[110,111] The wide variability in the results of this survey reflect the lack of clear guidelines for VTE prophylaxis in ankle fractures. Despite the lack of strong evidence supporting routine prophylaxis, 55% of respondents recommended the use of prophylaxis in a healthy 50-year-old patient with an ankle fracture. This rate increased to 86% when multiple comorbidities (obesity, diabetes, unable to mobilize with crutches/walker) were added, supporting the use of risk-stratification.

Conclusions:

The management of ankle fractures remains well-developed, but controversial. This is reflected in the variability of treatment preferences reported by the respondents in this survey. The reported preferences of OTA members and this review of the current literature will hopefully inform the reader in their future treatment of ankle fractures.

Recommendations:

See Table 1.

1. Moderate evidence supports the use of stress radiographs (either manual, gravity, or weight-bearing) in all isolated OTA/AO 44B fibula fractures without a clear history of dislocation, to determine stability and treatment.[11-14] *Strength of recommendation: Moderate.*
2. Moderate evidence supports that either a lateral or posterolateral plate may be used for fibular fixation, at the discretion of the treating surgeon.[21-23] *Strength of recommendation: Moderate.*
3. Moderate evidence supports the use of intraoperative stress examination of the syndesmosis following the fixation of all OTA/AO 44B fibula fractures.[28-30] *Strength of recommendation: Moderate.*
4. Limited evidence supports early weight-bearing and mobilization for surgically stabilized bimalleolar ankle fractures, without syndesmotic injury.[33-37] *Strength of recommendation: Limited.*

5. Strong evidence supports accurate reduction of the syndesmosis, either using fluoroscopic techniques or direct open visualization.[41-43] *Strength of recommendation: Strong*.
6. Strong evidence recommends against the routine removal of syndesmosis screws to improve outcomes in the absence of ongoing symptoms.[70-72] *Strength of recommendation: Strong.*
7. Moderate evidence supports flexible fixation of the syndesmosis with a suture-button device as an alternative to screw fixation.[80-82] *Strength of recommendation: Moderate.*
8. Moderate evidence supports fixation of the posterior malleolus with posterior plating over screw fixation alone.[100-102] *Strength of recommendation: Moderate.*
9. Strong evidence recommends against routine VTE prophylaxis in the absence of multiple risk factors.[105-109] *Strength of recommendation: Strong.*
10. Moderate evidence supports consideration of chemical VTE prophylaxis in patients with identified risk factors.[110,111] *Strength of recommendation: Moderate.*

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Table 1.

Recommendations	Strength of recommendation	References
Stress radiographs (either manual, gravity, or weight-bearing) should be used in all isolated OTA/AO 44B fibula fractures without a clear history of dislocation, to determine stability and treatment	Moderate	14-17
Either a lateral or posterolateral plate may be used for fibular fixation, at the discretion of the treating surgeon	Moderate	24-26
Intraoperative stress examination of the syndesmosis should be performed following the fixation of all OTA/AO 44B fibula fractures	Moderate	30-32
Early weight-bearing and mobilization may be considered for surgically stabilized bimalleolar ankle fractures, without syndesmotic injury	Limited	35-39
Accurate reduction of the syndesmosis, either using fluoroscopic techniques or direct open visualization must be obtained	Strong	43-45
Syndesmosis screws should not be routinely removed to improve outcomes in the absence of ongoing symptoms	Strong	72-74
Flexible fixation of the syndesmosis with a suture-button device may be considered as an alternative to screw fixation	Moderate	82-84
Fixation of the posterior malleolus with posterior plating over screw fixation alone	Moderate	102-104
Routine VTE prophylaxis in the absence of multiple risk factors is not required	Strong	107-111
Chemical VTE prophylaxis should be considered in patients with identified risk factors	Moderate	112,113

Table 2. Recommendations

	Strength of recommendation	References
Stress radiographs (either manual, gravity, or weight-bearing) should be used in all isolated OTA/AO 44B fibula fractures without a clear history of dislocation, to determine stability and treatment	Moderate	14-17
Either a lateral or posterolateral plate may be used for fibular fixation, at the discretion of the treating surgeon	Moderate	24-26
Intraoperative stress examination of the syndesmosis should be performed following the fixation of all OTA/AO 44B fibula fractures	Moderate	30-32
Early weight-bearing and mobilization may be considered for surgically stabilized bimalleolar ankle fractures, without syndesmotic injury	Limited	35-39
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