

Acute Trauma to the Ankle
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Berbaum KS, el-Khoury GY, Franken EA, Jr., Kathol M, Montgomery WJ, Hesson W. Impact of clinical history on fracture detection with radiography. <i>Radiology</i> . 1988;168(2):507-511.	Review/Other-Dx	40 radiographs of the extremities	To study the effect of knowledge of localizing symptoms and signs in the detection of fractures.	In 26 cases, a subtle fracture was present; 14 cases were normal. In half of the cases at each session, the precise location of pain, tenderness, or swelling was provided. The observer was asked to determine if the case was normal or abnormal (provide the exact location of the fracture) and to indicate the degree of confidence in the diagnosis. Responses were converted to a numeric scale for analysis. Analysis of ROC parameters indicates that clues regarding location of trauma facilitate detection of fractures. The improvement is based largely on an increased true-positive rate without an increased false-positive rate, regardless of the decision criteria of the radiologist (overall willingness to "overread" or "underread"). This has direct clinical applicability and reinforces the plea of radiologists for precise clinical information.	4
2. Berbaum KS, Franken EA, Jr., el-Khoury GY. Impact of clinical history on radiographic detection of fractures: a comparison of radiologists and orthopedists. <i>AJR Am J Roentgenol</i> . 1989;153(6):1221-1224.	Review/Other-Dx	40 radiographs of the extremities were examined twice by 7 orthopedic surgeons	To evaluate the influence that knowledge of localizing clinical signs has on the accuracy of fracture detection by orthopedic surgeons and compare the results with those of an identical study of radiologists performed earlier.	In 26 cases, a subtle fracture was present; 14 cases were normal. During one interpretation of the radiographs of each case, the precise location of pain, tenderness, or swelling was provided; during the other, this information was withheld. Analysis of ROC parameters indicates that the clues regarding location of trauma facilitate detection of fractures by orthopedists (an 11% improvement in Az, the area under the ROC curve, $F[1,12] = 49.67$, $P < .001$). This finding is similar to the results of the earlier study with radiologists (a 6% improvement in Az, $F[1,12] = 14.77$, $P < .005$). Statistical comparison of the 2 experiments showed that orthopedists depend on this information much more than do radiologists, demonstrated by a statistically significant prompting-by-specialty interaction ($F[1,12] = 5.13$, $P < .05$). Localization clues improve ability of orthopedic surgeons to detect fractures in the trauma patient even more than they improve the ability of radiologists.	4

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3. Brandser EA, Berbaum KS, Dorfman DD, et al. Contribution of individual projections alone and in combination for radiographic detection of ankle fractures. <i>AJR Am J Roentgenol.</i> 2000;174(6):1691-1697.	Observational-Dx	433 ankle radiographs series	To determine whether the standard 3-view ankle radiographic series could be replaced by a 2-view combination, and if so, which 2-view combination (anteroposterior with lateral or mortise with lateral) would be superior.	The data provide little support for preferring either 2-view combination (anteroposterior-lateral or mortise-lateral) for any type of fracture. The 3-view combination does detect significantly more fractures than some 2-view combinations in some locations, and there is a statistically significant cost in diagnostic accuracy for eliminating the anteroposterior or mortise view.	3
4. Clark TW, Janzen DL, Ho K, Grunfeld A, Connell DG. Detection of radiographically occult ankle fractures following acute trauma: positive predictive value of an ankle effusion. <i>AJR Am J Roentgenol.</i> 1995;164(5):1185-1189.	Observational-Dx	33 patients	To determine if the presence of an ankle effusion on radiographs after acute ankle trauma is predictive of occult ankle fracture when no fracture is visible on the standard radiographic series.	11/33 patients with ankle effusions and otherwise normal radiographs had occult fractures identified with tomography. The fracture sites were as follows: osteochondral fracture of talar dome (n = 4), neck of talus (n = 1), medial malleolus (n = 1), anterior tibial rim (n = 1), posterior tibial rim (n = 1), tibial plafond (n = 1), lateral malleolus (n = 1), and anterior process of calcaneus (n = 1). The radiographic size of an ankle effusion was predictive of occult fracture. An ankle effusion measuring ≥ 13 mm in anterior plus posterior capsular distension had an 82% sensitivity and 91% specificity for underlying fracture. The PPV of an ankle effusion ≥ 13 mm was 82%.	3
5. Anis AH, Stiell IG, Stewart DG, Laupacis A. Cost-effectiveness analysis of the Ottawa Ankle Rules. <i>Ann Emerg Med.</i> 1995;26(4):422-428.	Review/Other-Dx	N/A	To conduct an incremental cost-effectiveness analysis of implementation of the OAR in emergency departments in the United States and Canada.	Radiography, waiting time, lost productivity, and medicolegal costs were calculated. In the United States, the savings varied between US\$614,226 and US\$3,145,910 per 100,000 patients, depending on the charge rate for radiography. In Ontario, Canada, the total savings were CAN\$730,145 per 100,000 patients. One- and two-way sensitivity analyses that varied the rate of missed fractures, cost of radiography, probability of lawsuits, and cost of lawsuits did not change the results substantially.	4

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6. Auletta AG, Conway WF, Hayes CW, Guisto DF, Gervin AS. Indications for radiography in patients with acute ankle injuries: role of the physical examination. <i>AJR Am J Roentgenol.</i> 1991;157(4):789-791.	Review/Other-Dx	201 patients	Prospective study was performed to test the hypothesis that a thorough physical examination can eliminate the need for a large number of radiographs obtained in patients with acute ankle trauma.	All patients, irrespective of the physical examination, underwent ankle radiography, and the results were correlated with those of the physical examination. On the basis of the results of the physical examinations, 101 (50%) of the radiologic studies were not indicated. In only 1 of these patients was a fracture seen on radiographs. The radiograph in this case showed a small avulsion fracture of the dorsal aspect of the talus that was clinically insignificant (no cast or surgery was required).	4
7. Brand DA, Frazier WH, Kohlhepp WC, et al. A protocol for selecting patients with injured extremities who need x-rays. <i>N Engl J Med.</i> 1982;306(6):333-339.	Review/Other-Dx	848 patients	To help curb excessive radiography, the authors developed a protocol for selecting patients with injured extremities who need x-ray examination, and tested the protocol prospectively in patients to determine its safety and effectiveness.	Strict adherence to the protocol would have reduced x-ray usage by 12% for upper extremities and 19% for lower extremities. The actual reductions were 5% and 16%, respectively, since further reductions were limited by patient's demands for x-ray examinations. One fracture in 287 were missed, but the treatment was appropriate and the outcome satisfactory. By eliminating superfluous x-ray procedures, the protocol could reduce charges by \$79 million to \$139 million nationwide, without compromising quality of care or increasing malpractice liability.	4
8. Dunlop MG, Beattie TF, White GK, Raab GM, Doull RI. Guidelines for selective radiological assessment of inversion ankle injuries. <i>Br Med J (Clin Res Ed).</i> 1986;293(6547):603-605.	Review/Other-Dx	500 patients	Prospective study was performed to establish definitive guidelines for selective use of radiography in the assessment of inversion ankle injuries.	There were 379 soft tissue injuries, 56 malleolar fractures, 40 avulsion fractures, 21 fractures at the base of the fifth metatarsal, and 4 calcaneal fractures. Multiple logistic regression identified distal fibular tenderness, age, and ability to bear weight as the most important clinical variables in predicting important fractures (P<.001). A policy of requesting x-ray examination of only those patients with distal fibular tenderness or inability to bear weight or aged over 60, with a further proviso that no foot radiographs should be obtained, would produce a 60% reduction in ankle radiography in this center without detriment to patient care.	4

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9. Gleadhill DN, Thomson JY, Simms P. Can more efficient use be made of x ray examinations in the accident and emergency department? <i>Br Med J (Clin Res Ed)</i> . 1987;294(6577):943-947.	Review/Other-Dx	12 casualty officers	A 2 part study was performed : (a) to determine whether the selection of patients for x-ray examination and the radiological skills of casualty officers alter during tenure of post and (b) to determine whether introducing clinical guidelines on referring patients for x-ray examination influences the number being requested by the department.	Overall, 4.9% of trauma radiographs were misinterpreted, but this fell from 7.1% to 2.9% during tenure of post. 1/4 errors was clinically important. Clinical guidelines for selective radiography produced a significant and sustained reduction in the number of x-ray examinations requested by the department. Analysis of one common injury indicated that the quality of patient care was not adversely affected.	4
10. Keogh SP, Shafi A, Wijetunge DB. Comparison of Ottawa ankle rules and current local guidelines for use of radiography in acute ankle injuries. <i>J R Coll Surg Edinb</i> . 1998;43(5):341-343.	Observational-Dx	252 patients	To assess any advantage of the OAR vs local guidelines for radiography of the acutely injured ankle or midfoot.	22 fractures were diagnosed radiologically. Both guidelines had a sensitivity of 1.0 in detecting fractures and a negative predictive value of 1.0. OAR guidelines produced a specificity of 0.48 and a PPV of 0.15. Local guidelines produced a specificity of 0.19 and a PPV of 0.1. Following OAR produced a highly significant reduction (X = 74.0 P<0.001) in radiography of 37%, and no fractures were missed. This could potentially save the department approximately 7500 Pounds per annum.	3
11. Montague AP, McQuillan RF. Clinical assessment of apparently sprained ankle and detection of fracture. <i>Injury</i> . 1985;16(8):545-546.	Review/Other-Dx	311 patients	The clinical features of patients with apparently sprained ankles were analyzed and compared with radiographs.	Measurable swelling was found to be a constant feature of ankle fractures and bruising was very common. The incidence of fractures increased with age. No other physical sign or the history was useful in predicting fracture in this context. It is concluded that advanced age, bruising and particularly swelling are strong indications for ankle radiography and the absence of swelling is a strong contraindication.	4
12. Pijnenburg AC, Glas AS, De Roos MA, et al. Radiography in acute ankle injuries: the Ottawa Ankle Rules versus local diagnostic decision rules. <i>Ann Emerg Med</i> . 2002;39(6):599-604.	Observational-Dx	647 patients	To validate the OAR and 2 Dutch ankle rules in distinguishing clinically significant fractures from insignificant fractures and other injuries in patients with a painful ankle presenting to the emergency department.	74 fractures were seen, of which 41 were clinically significant. The OAR had a sensitivity of 98% for identifying clinically significant fractures; the local rules scored 88% and 59%, respectively. The potential savings in radiographs for the 3 decision rules were 24%, 54%, and 82%, respectively. The area under the ROC curve was better for both the local rules (0.84 and 0.83) compared with the OAR (0.76).	2

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13. Stiell IG, Greenberg GH, McKnight RD, et al. Decision rules for the use of radiography in acute ankle injuries. Refinement and prospective validation. <i>JAMA</i> . 1993;269(9):1127-1132.	Observational-Dx	First stage 1,032 of 1,130 eligible patients: Second stage 453 of 530 eligible patients	To validate and refine previously derived clinical decision rules that aid the efficient use of radiography in acute ankle injuries. Survey prospectively administered in two stages: validation and refinement of the original rules (first stage) and validation of the refined rules (second stage).	OAR is 100% sensitive for fractures, reliable, and has the potential to allow physicians to safely reduce the number of radiographs ordered in patients with ankle injuries by one-third.	1
14. Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. <i>Ann Emerg Med</i> . 1992;21(4):384-390.	Observational-Dx	155 adults	To develop decision rules that will predict fractures in patients with ankle injuries, thereby assisting clinicians in being more selective in their use of radiography.	All 70 significant malleolar fractures found in the 689 ankle radiographic series performed were identified among people who had pain near the malleoli and were age 55 years or more, had localized bone tenderness of the posterior edge or tip of either malleolus, or were unable to bear weight both immediately after the injury and in the emergency department. This rule was 100% sensitive and 40.1% specific for detecting malleolar fractures and would allow a reduction of 36.0% of ankle radiographic series ordered. Similarly, all 32 significant midfoot fractures on the 230 foot radiographic series performed were found among patients with pain in the midfoot and bone tenderness at the base of the fifth metatarsal, the cuboid, or the navicular.	3
15. Vargish T, Clarke WR, Young RA, Jensen A. The ankle injury--indications for the selective use of X-rays. <i>Injury</i> . 1983;14(6):507-512.	Review/Other-Dx	150 patients	24 independent variables which might help distinguish between soft tissue injuries and fractures at the ankle were identified and then used prospectively to study patients with ankle injuries.	19 patients had fractured ankles (12.7%) and 131 (87.3%) had soft tissue injuries. Only the patient's ability to bear weight on the injured ankle and the presence of tenderness over the lateral aspect of the ankle below the malleolus proved to be helpful. When these 2 signs were present together, regardless of all other variables, there was a 97.5% probability of soft tissue injury $P \sim 0.005$. This study suggests that careful patient assessment will permit more discriminating use of ankle x-rays.	4

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16. Lambers K, Ootes D, Ring D. Incidence of patients with lower extremity injuries presenting to US emergency departments by anatomic region, disease category, and age. <i>Clin Orthop Relat Res.</i> 2012;470(1):284-290.	Review/Other-Dx	119,815 patients	To determine the anatomic regions, disease categories, and circumstances that account for the highest incidence of leg problems among patients presenting to emergency departments in the United States.	The authors identified 112 unique combinations of disease categories and anatomic regions. Strains and sprains accounted for 36% of all lower extremity injuries. The injury with the greatest incidence was an ankle sprain (206 per 100,000; 95% CI, 181-230). Younger patients were more likely to have ankle sprains, foot contusions/abrasions, and foot strains/sprains. Older patients were more likely to have lower trunk fractures and lower trunk contusions/abrasions. The most common incidence for injury was at home (45%).	4
17. Waterman BR, Belmont PJ, Jr., Cameron KL, Deberardino TM, Owens BD. Epidemiology of ankle sprain at the United States Military Academy. <i>Am J Sports Med.</i> 2010;38(4):797-803.	Review/Other-Dx	614 cadets	A longitudinal cohort study was performed to determine the effect of risk factors for ankle sprain at the United States Military Academy between 2005 and 2007.	614 cadets sustained new ankle sprains during 10,511 person-years at risk, resulting in overall incidence rates of 58.4 per 1,000 person-years. Women (96.4), compared with men (52.7), had a significantly increased rate ratio for ankle sprain of 1.83 (95% CI, 1.52-2.20). Men with ankle sprains had higher mean height, weight, and body mass index than uninjured men (P<.001). Men with ankle sprains had higher average scores in push-ups, sit-ups, and run time than uninjured men (P<.001). Ankle sprain occurred most commonly during athletics (64.1%). Ankle sprain IR did not significantly differ between intercollegiate and intramural athletic competition after controlling for athlete-exposure (increased rate ratio, 1.05; 95% CI, 0.81-1.37). The ankle sprain increased rate ratio of female compared with male intercollegiate athletes was 0.93 (95% CI, 0.67-1.32) per 1,000 person-years and 1.04 (95% CI, 0.74-1.47) per 1,000 athlete-exposures. The intercollegiate sports of men's rugby, women's cheerleading, and men's/women's basketball, soccer, and lacrosse had the highest ankle sprain incidence rates.	4

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18. Morris N, Lovell ME. Demographics of 3929 ankle injuries, seasonal variation in diagnosis and more fractures are diagnosed in winter. <i>Injury</i> . 2013;44(7):998-1001.	Review/Other-Dx	3,929 patients	An audit was performed to look at the diagnostic or pick-up rate of ankle fractures. An automated x-ray system was looked at to see the number of x-rays taken and the diagnostic yield.	Ankle x-rays of 3,929 patients over a 24-month period between 1 July 2009 and 31 June 2011; of which, 612 patients were found to have fractured their ankle giving a pick-up rate of 0.16. This is less than what might be expected with strict application of OAR. The pick-up rate fluctuated each month from an admirable 0.35 fractures per x-ray ordered in December 2009 to a lowly 0.06 fractures per x-ray in May 2010. The same pattern was noted for the other year. For both Decembers, the fewest number of x-rays were taken at 80 and 140, the most at 200 and 240 in May for both years. Less x-rays were taken in for all OAR months. For younger age groups, males dominated with the crossover to females dominating in the fifth decade.	4

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19. Darrow CJ, Collins CL, Yard EE, Comstock RD. Epidemiology of severe injuries among United States high school athletes: 2005-2007. <i>Am J Sports Med.</i> 2009;37(9):1798-1805.	Review/Other-Dx	1,378 severe injuries	A descriptive epidemiology study on severe injury rates and patterns by gender and type of exposure.	Participating certified athletic trainers reported 1,378 severe injuries during 3 550 141 athlete-exposures (0.39 severe injuries per 1,000 athletic exposures). Football had the highest severe injury rate (0.69), followed by wrestling (0.52), girls' basketball (0.34), and girls' soccer (0.33). The rate in all boys' sports (0.45) was higher than all girls' sports (0.26) (rate ratio, 1.74; 95% CI, 1.54-1.98; P<.001). However, among directly comparable sports (soccer, basketball, and baseball/softball), girls sustained a higher severe injury rate (0.29) than boys (0.23) (rate ratio, 1.28; 95% CI, 1.08-1.52; P=.006). More specifically, girls' basketball had a higher rate (0.34) than boys' basketball (0.24) (rate ratio, 1.43; 95% CI, 1.10-1.86; P=.009). Differences between boys' and girls' soccer and baseball/softball were not statistically significant. The severe injury rate was greater in competition (0.79) than practice (0.24) (rate ratio, 3.30; 95% CI, 2.97-3.67; P<.001). Nationally, high school athletes sustained an estimated 446 715 severe injuries from 2005-2007. The most commonly injured body sites were the knee (29.0%), ankle (12.3%), and shoulder (10.9%). The most common diagnoses were fractures (36.0%), complete ligament sprains (15.3%), and incomplete ligament sprains (14.3%). Of severe sports injuries, 0.3% resulted in medical disqualification for the athletes' career, and an additional 56.8% resulted in medical disqualification for the entire season. One in 4 (28.3%) severe injuries required surgery, with over half (53.9%) being knee surgeries.	4
20. Garrick JG. Epidemiologic perspective. <i>Clin Sports Med.</i> 1982;1(1):13-18.	Review/Other-Dx	3,049 participants in 19 sports sustaining 1,181 injuries	To review epidemiology of sports related trauma.	No results stated in abstract.	4

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21. Lucchesi GM, Jackson RE, Peacock WF, Cerasani C, Swor RA. Sensitivity of the Ottawa rules. <i>Ann Emerg Med.</i> 1995;26(1):1-5.	Observational-Dx	484 patients	To validate criteria predicting ankle and mid-foot fractures with 100% sensitivity.	587 radiographs were obtained in 484 patients. 421 were of the ankle, and 149 were of the foot. There were 93 ankle fractures and 29 midfoot fractures, giving a fracture yield of 22.1% for ankle films and 19.5% for foot films. Decision rules had sensitivity of 94.6% and specificity of 15.5% for ankle fractures and sensitivity of 93.1% and specificity of 11.5% for midfoot fractures. Prospective criteria failed to predict fracture in 5 of the ankle group and 2 of the midfoot group. Physicians predicting fracture solely on the basis of clinical suspicion had a sensitivity of 69% in ankle injuries and 76% in midfoot injuries.	3
22. Kerkhoffs GM, van den Bekerom M, Elders LA, et al. Diagnosis, treatment and prevention of ankle sprains: an evidence-based clinical guideline. <i>Br J Sports Med.</i> 2012;46(12):854-860.	Review/Other-Dx	N/A	Evidence-based clinical guidelines for the diagnosis, treatment and prevention of ankle sprains.	N/A	4
23. Polzer H, Kanz KG, Prall WC, et al. Diagnosis and treatment of acute ankle injuries: development of an evidence-based algorithm. <i>Orthop Rev (Pavia).</i> 2012;4(1):e5.	Review/Other-Dx	N/A	To systematically search the current literature, classify the evidence, and develop an algorithm for the diagnosis and treatment of acute ankle injuries.	According to the currently available literature, the following recommendations have been formulated: i) the OAR should be applied in order to rule out fractures; ii) physical examination is sufficient for diagnosing injuries to the lateral ligament complex; iii) classification into stable and unstable injuries is applicable and of clinical importance; iv) the squeeze-, crossed leg- and external rotation test are indicative for injuries of the syndesmosis; v) MRI is recommended to verify injuries of the syndesmosis; vi) stable ankle sprains have a good prognosis while for unstable ankle sprains, conservative treatment is at least as effective as operative treatment without the related possible complications; vii) early functional treatment leads to the fastest recovery and the least rate of re-injury; viii) supervised rehabilitation reduces residual symptoms and re-injuries.	4

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<p>24. Seah R, Mani-Babu S. Managing ankle sprains in primary care: what is best practice? A systematic review of the last 10 years of evidence. <i>Br Med Bull.</i> 2011;97:105-135.</p>	<p>Review/Other-Dx</p>	<p>33 articles</p>	<p>To summarize the best available evidence in the last decade for managing ankle sprains.</p>	<p>Ankle sprains occur commonly but their management is not always readily agreed. The OAR are ubiquitous in the clinical pathway and can be reliably applied by emergency care physicians, primary care physicians and triage nurses. For mild-to-moderate ankle sprains, functional treatment options (which can consist of elastic bandaging, soft casting, taping or orthoses with associated coordination training) were found to be statistically better than immobilization for multiple outcome measures. For severe ankle sprains, a short period of immobilization in a below-knee cast or pneumatic brace results in a quicker recovery than tubular compression bandage alone. Lace-up supports are a more effective functional treatment than elastic bandaging and result in less persistent swelling in the short term when compared with semi-rigid ankle supports, elastic bandaging and tape. Semi-rigid orthoses and pneumatic braces provide beneficial ankle support and may prevent subsequent sprains during high-risk sporting activity. Supervised rehabilitation training in combination with conventional treatment for acute lateral ankle sprains can be beneficial, although some of the studies reviewed gave conflicting outcomes. Therapeutic hyaluronic acid injections in the ankle are a relatively novel non-surgical treatment but may have a role in expediting return to sport after ankle sprain. There is a role for surgical intervention in severe acute and chronic ankle injuries, but the evidence is limited.</p>	<p>4</p>

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25. Lin CW, Uegaki K, Coupe VM, Kerkhoffs GM, van Tulder MW. Economic evaluations of diagnostic tests, treatment and prevention for lateral ankle sprains: a systematic review. <i>Br J Sports Med.</i> 2012.	Review/Other-Dx	10 studies	To assess and summarize the economic evidence regarding diagnostic tests, treatment and prevention for lateral ankle sprains.	A total of 230 records were identified; 10 studies were included. 5 studies conducted a full economic evaluation and 5 studies involved cost analyses. Lack of blinding was the main risk of bias. The methodological quality of the full economic evaluations was fairly good. Valuation of costs, measurement of outcomes and sensitivity analysis were points for improvement. Single studies showed that the OAR was cost effective for diagnosing lateral ankle sprains in the emergency setting compared with existing hospital protocols; acute treatment with anti-inflammatory medication and the plaster cast for severe sprains appeared cost effective; and neuromuscular training was cost effective in preventing ankle re-injury.	4
26. Wynn-Thomas S, Love T, McLeod D, et al. The Ottawa ankle rules for the use of diagnostic X-ray in after hours medical centres in New Zealand. <i>N Z Med J.</i> 2002;115(1162):U184.	Observational-Dx	450 general practitioners	To measure baseline use of OAR, validate the OAR and, if appropriate, explore the impact of implementing the Rules on x-ray rates in a primary care, after hour's medical center setting.	Awareness of the OAR was low. The sensitivity of the OAR for diagnosis of fractures was 100% (95% CI, 75.3–100) and the specificity was 47% (95% CI, 40.5–54.5). The sensitivity of general practitioners clinical judgment was 100% (95% CI, 75.3–100) and the specificity was 37% (95% CI, 30.2–44.2). Implementing the OAR would reduce x-ray utilization by 16% (95% CI: approx. 10.8–21.3).	3
27. Dowdall H, Gee M, Brison RJ, Pickett W. Utilization of radiographs for the diagnosis of ankle fractures in Kingston, Ontario, Canada. <i>Acad Emerg Med.</i> 2011;18(5):555-558.	Observational-Dx	7,706 acute ankle injuries	To assess the utilization and clinical yield of radiographs ordered to assist in the diagnosis of acute ankle injuries presenting to 2 emergency departments in Kingston, Ontario, Canada, over a 7-year period.	Following exclusions, 7,706 acute ankle injuries were identified for analysis. Utilization of radiography increased modestly over time, to a high of 70.3% (95% CI, 67.3%–72.9%) in 2007. The percentage of cases positive for fracture remained consistent (18.3%–21.9% annually).	4

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28. Derksen RJ, Bakker FC, Geervliet PC, et al. Diagnostic accuracy and reproducibility in the interpretation of Ottawa ankle and foot rules by specialized emergency nurses. <i>Am J Emerg Med.</i> 2005;23(6):725-729.	Observational-Dx	106 patients	To evaluate the diagnostic accuracy and reproducibility of specialized emergency nurses in assessing ankle sprains by applying the OAR and Ottawa Foot Rules.	106 injuries were assessed in pairs, of which 14 were ultimately found to concern acute fractures (prevalence, 13%). The sensitivity for the specialized emergency nurse group was 0.93 (95% CI, 0.64-1.00) compared with 0.93 (95% CI, 0.64-1.00) for the house officer group (no significance [ns]). The specificity of the nurses was 0.49 (95% CI, 0.38-0.60) compared with 0.39 (95% CI, 0.29-0.50) for the doctors (ns). The PPV for the specialized emergency nurse group was 0.22 (95% CI, 0.13-0.35) compared with 0.19 (95% CI, 0.11-0.31) for the house officer group (ns). The negative predictive value for the nurses was 0.98 (95% CI, 0.87-1.00) compared with 0.97 (95% CI, 0.84-1.00) for the doctors (ns). The interobserver agreement for the OAR and Ottawa Foot Rules subsets was kappa = 0.38 for the lateral malleolus; kappa = 0.30, medial malleolus; kappa = 0.50, navicular; kappa = 0.45, metatarsal V base; and kappa = 0.43, weight-bearing. The overall interobserver agreement for the OAR was kappa = 0.41 and kappa = 0.77 for the Ottawa Foot Rules.	2
29. Bachmann LM, Kolb E, Koller MT, Steurer J, ter Riet G. Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. <i>BMJ.</i> 2003;326(7386):417.	Review/Other-Dx	32 studies met inclusion criteria; 27 studies (15,581 patients) for pooled analysis	Systematic review to examine the accuracy of OAR for excluding fractures of the ankle and mid-foot.	Pooled negative likelihood ratios for the ankle and mid-foot were 0.08 (95% CI, 0.03–0.18) and 0.08 (0.03–0.20), respectively. The pooled negative likelihood ratio for both regions in children was 0.07 (0.03–0.18). Applying these ratios to a 15% prevalence of fracture gave a <1.4% probability of actual fracture in these subgroups. Evidence supports the (OAR) as an accurate instrument for excluding fractures of the ankle and mid-foot. The instrument has a sensitivity of almost 100% and a modest specificity, and its use should reduce the number of unnecessary radiographs by 30%-40%.	4

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30. Dowling S, Spooner CH, Liang Y, et al. Accuracy of Ottawa Ankle Rules to exclude fractures of the ankle and midfoot in children: a meta-analysis. <i>Acad Emerg Med.</i> 2009;16(4):277-287.	Review/Other-Dx	12 studies (n=3,130)	Systematic review to determine the diagnostic accuracy of the OAR to exclude ankle and midfoot fractures in children and the extent to which x-ray use could be reduced without missing significant fractures.	Pooled sensitivity was 98.5% (95% CI, 97.3–99.2). 4/10 missed fractures were characterized: 1 Salter-Harris-I, 1 Salter-Harris-IV, and 2 “insignificant fractures” (either Salter-Harris-I or avulsion fractures <3 mm). The pooled estimate for rate of x-ray reduction was 24.8% (95% CI, 23.3%–26.3%; range = 5%–44%). OAR appears to be a reliable tool to exclude fractures in children >5 years of age presenting with ankle and midfoot injuries. Employing the OAR would significantly decrease x-ray use with a low likelihood of missing a fracture.	4
31. Leddy JJ, Smolinski RJ, Lawrence J, Snyder JL, Priore RL. Prospective evaluation of the Ottawa Ankle Rules in a university sports medicine center. With a modification to increase specificity for identifying malleolar fractures. <i>Am J Sports Med.</i> 1998;26(2):158-165.	Observational-Dx	132 patients	To prospectively evaluate the OAR over 1 year for their ability to identify clinically significant ankle and midfoot fractures and to reduce the need for radiography.	There were 11 clinically significant fractures (fracture rate, 8.3% per year). In these 132 patients, the OAR would have reduced the need for radiography by 34%, without any fractures being missed (sensitivity 100%, specificity 37%). In 78 patients, the specificity for malleolar fracture for the new rule was significantly greater than that of the OAR malleolar rule (59% vs 42%), sensitivity remained 100%, and the potential reduction in the need for radiography (54%) was significantly greater.	2

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
32. Dissmann PD, Han KH. The tuning fork test--a useful tool for improving specificity in "Ottawa positive" patients after ankle inversion injury. <i>Emerg Med J.</i> 2006;23(10):788-790.	Observational-Dx	24 women	To determine the suitability of tuning fork testing in combination with existing Ottawa guidance for increasing the specificity in detecting fractures of the lateral malleolus.	The observed prevalence of ankle fractures was 5/49 (10%). Sensitivity and specificity were calculated as 100% and 61%, respectively, for tuning fork testing on the tip of the lateral malleolus, and as 100% and 95%, respectively, for testing on the distal fibula shaft. The associated positive and negative likelihood ratios were 2.59 and 0 (tip of the lateral malleolus), and 22 and 0 (distal fibula shaft), respectively. The data were significant, with P=0.014 (tip of the lateral malleolus) and P<0.001 (distal fibula shaft). The study suggests that additional tuning fork testing of "Ottawa positive" patients may lead to a marked reduction in ankle radiographs, with consequently reduced radiation exposure and journey time. This may be particularly relevant in situations where radiological facilities are not readily available (expedition medicine) or where access to these has to be prioritized (major incidents, natural catastrophes).	2
33. Eggli S, Scwabas GM, Zimmermann H, Exadaktylos AK. The Bernese ankle rules: a fast, reliable test after low-energy, supination-type malleolar and midfoot trauma. <i>J Trauma.</i> 2005;59(5):1268-1271.	Observational-Dx	364 patients	The authors introduced a new indirect stress technique to examine the ankle and the midfoot after low-energy, supination-type trauma, avoiding direct palpation of the injured region.	In 354 prospectively documented patients, the Bernese ankle test produced a sensitivity of 100% and a specificity of 91%.	3
34. Petscavage J, Baker SR, Clarkin K, Luk L. Overuse of concomitant foot radiographic series in patients sustaining minor ankle injuries. <i>Emerg Radiol.</i> 2010;17(4):261-265.	Review/Other-Dx	243 patients	To retrospectively review radiographic studies of all patients over a period of 18 months who simultaneously had ankle and foot radiographs performed for acute complaints limited to the ankle alone.	Of the 243 patients who met the inclusion criteria, 55 patients had fractures, 46 in or near the ankle joint, and 9 which were located at the base of the fifth metatarsal bone. No fractures or dislocations were noted elsewhere in the foot. All of the fifth metatarsal fractures were evident on adequately performed ankle series. The findings suggest that films of the foot are not necessary when trauma is limited to the ankle and when an appropriately performed ankle series has been completed.	4

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
35. Diehr P, Highley R, Dehkordi F, et al. Prediction of fracture in patients with acute musculoskeletal ankle trauma. <i>Med Decis Making</i> . 1988;8(1):40-47.	Review/Other-Dx	587 patients	To find clinical predictors for the presence of fracture in patients presenting with ankle trauma, and to develop and describe a rule that can decrease x-ray utilization without adversely affecting patient care.	The association of each variable with the final diagnosis of fracture, rupture, or sprain was tested; 21 variables were significant predictors of fracture (vs sprain and rupture) and 15 were not significantly associated with final diagnosis.	4
36. Schock HJ, Pinzur M, Manion L, Stover M. The use of gravity or manual-stress radiographs in the assessment of supination-external rotation fractures of the ankle. <i>J Bone Joint Surg Br</i> . 2007;89(8):1055-1059.	Observational-Dx	29 patients	To compare the clinical efficacy and discomfort to the patient associated with the examination of both manual- and gravity-stress in the diagnosis of SER-IV equivalent injuries of the ankle.	Both examinations in 29 patients with SER fractures were undertaken. Of these, 16 (55%) were stress-positive, i.e. and had widening of the medial clear space of >4 mm with a mean medial clear space of 6.09 mm (4.4 to 8.1) on gravity-stress and 5.81 mm (4.0 to 8.2) on manual-stress examination, and 13 patients (45%) were stress-negative with a mean medial clear space of 3.91 mm (3.3 to 5.1) and 3.61 mm (2.6 to 4.5) on examination of gravity- and manual-stress respectively. The mean absolute visual analogue scale score for discomfort in the examination of gravity stress was 3.45 (1 to 6) and in the manual-stress procedure 6.14 (3 to 10).	3
37. McLaughlin SA, Binder DS, Sklar DP. Ottawa ankle rules and the diabetic foot. <i>Ann Emerg Med</i> . 1998;32(4):518.	Review/Other-Dx	N/A	Letter to editor commenting on the role of OAR in a diabetic woman.	Diabetic patients with sensory neuropathy should be part of the exclusion criteria for use of OAR.	4
38. Coll AP. Ottawa rules, OK? Rules are different in diabetes. <i>BMJ</i> . 2009;339:b3507.	Review/Other-Dx	N/A	A comment on Ottawa rules.	No results stated in abstract.	4
39. Clark TW, Janzen DL, Logan PM, Ho K, Connell DG. Improving the detection of radiographically occult ankle fractures: positive predictive value of an ankle joint effusion. <i>Clin Radiol</i> . 1996;51(9):632-636.	Observational-Dx	26 patients	To assess the value of an ankle effusion on radiographs as a predictor of radiographically occult fracture after acute ankle trauma.	12 patients (46%) had radiographically occult fractures identified with CT. Fracture sites included: posterior or lateral malleoli (n = 4), calcaneus (n = 1), or talus (n = 7). Ankle effusion size was 11.2 mm in the group without fracture and 17.1 mm in the group with fracture (P<0.0001). The PPV of an effusion ≥15 mm was 83%. CT detected significant soft-tissue injuries in 4 (15%) patients including peroneal retinaculum tear (n = 1), anterior talofibular ligament avulsion (n = 1), and tears of the peroneus longus (n = 1) and tibialis posterior (n = 1) tendons.	3

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
40. Hou Z, Zhang L, Zhang Q, et al. The "communication line" suggests occult posterior malleolar fracture associated with a spiral tibial shaft fracture. <i>Eur J Radiol.</i> 2012;81(3):594-597.	Review/Other-Dx	96 patients	To demonstrate radiographical characteristics of the relationship between distal spiral tibial shaft fractures and associated occult posterior malleolar fractures that confirmed by CT and MRI.	The spiral tibia fracture line was contiguous with posterior malleolar fractures in 89 of 96 cases after evaluation with the CT and MRI. The line connecting the two injuries, which occurs between the medial inferior apex of the spiral tibia fracture line and the posterior superior apex of the posterior malleolar fractures was identified as the "communication line". In 47 of the 89 conjunction fractures, the "communication line" was detectable preoperatively and in 12 cases postoperatively by anteroposterior radiograph. By using the CT and MRI scans, the authors found that no "communication line" was present in only 7 cases.	4
41. Haapamaki VV, Kiuru MJ, Koskinen SK. Ankle and foot injuries: analysis of MDCT findings. <i>AJR Am J Roentgenol.</i> 2004;183(3):615-622.	Observational-Dx	388 patients	Retrospective study to assess MDCT findings and the advantages of MDCT compared with radiography in patients referred to a level 1 trauma center for diagnostic evaluation of acute ankle and foot trauma.	344 (89%) of the 388 patients had one or more fractures in the ankle or foot. Calcaneus was the most commonly fractured bone, and the sensitivity of radiography in the detection of calcaneal fractures was 87%. The sensitivity of radiography in the detection of talar fractures was 78%, whereas it was only 25%-33% in the detection of midfoot fractures. A Lisfranc fracture-dislocation was not detected on primary radiography in 5 (24%) of 21 cases. The 3 main injury mechanisms were falling from a height (164 patients [48%]), a simple fall (68 patients [20%]), and a traffic accident (47 patients [14%]). In patients with injuries from high-energy polytrauma and in those with complex ankle and foot fractures, the sensitivity of radiography is only moderate to poor; in these cases, MDCT is recommended as the primary imaging technique.	3

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
42. Rempalik P, Stabler A, Merl T, Roemer F, Bohndorf K. Diagnosis of acute fractures of the extremities: comparison of low-field MRI and conventional radiography. <i>Eur Radiol.</i> 2004;14(4):625-630.	Observational-Dx	78 (41 fractures, 37 without fracture) patients	To compare low-field MRI (0.2 T) and conventional radiography for the detection of acute fractures of the distal part of the extremities.	The MRI and conventional radiography revealed an accuracy of 81.4% and of 79.5%, respectively, in the detection of acute fractures. The diagnostic accuracy of MRI to detect fractures in the hand and forefoot proved to be significantly inferior to conventional X-ray examinations. On the other hand, MRI achieved a better accuracy for the examination of bones near a large joint. The interobserver variability for both methods was rated as moderate. In ROC analysis both methods were rated as good. There was no statistical difference of the accuracy between low-field MRI and conventional radiography in the detection of acute fractures of the distal part of the extremities.	3
43. Nikken JJ, Oei EH, Ginai AZ, et al. Acute ankle trauma: value of a short dedicated extremity MR imaging examination in prediction of need for treatment. <i>Radiology.</i> 2005;234(1):134-142.	Experimental-Dx	197 patients	To assess predictive value of a short MRI examination with or instead of radiography performed in patients with acute ankle trauma to identify those who require additional treatment versus those who do not and can be discharged without further follow-up.	In univariable analysis, age (OR, 1.02; 95% CI, 1.00, 1.04), radiographic results (OR, 7.92; 95% CI, 3.17, 19.8), and positive or uncertain results in patients who underwent MRI vs patients who did not (OR, 2.42; 95% CI, 1.25, 4.70) were predictive of treatment. In the multivariable analysis, positive or uncertain MRI results (OR, 2.61; 95% CI, 1.28, 5.30) contributed significantly to prediction of subsequent treatment. Negative MRI results did not contribute significantly (OR, 0.66; 95% CI, 0.27, 1.61).	1
44. Longo UG, Loppini M, Romeo G, van Dijk CN, Maffulli N, Denaro V. Bone bruises associated with acute ankle ligament injury: do they need treatment? <i>Knee Surg Sports Traumatol Arthrosc.</i> 2013;21(6):1261-1268.	Review/Other-Dx	9 studies	To analyze the current knowledge, incidence, relevance, and need for treatment of bone bruises associated with acute ankle ligament injury.	No randomized controlled trials or prospective cohort studies were found. Only case series were retrieved. A critical appraisal for validity and usefulness of the studies revealed that the best level of evidence on this topic is represented by retrospective comparative studies. Nine studies evaluating the management of bone bruises associated with acute ankle ligament injuries were found.	4

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
45. Sankar WN, Chen J, Kay RM, Skaggs DL. Incidence of occult fracture in children with acute ankle injuries. <i>J Pediatr Orthop.</i> 2008;28(5):500-501.	Review/Other-Dx	37 children	To determine the incidence of occult fracture in children with acute ankle injuries and the risk of fracture displacement.	By 3 weeks after injury, there was periosteal new bone formation about the distal fibula in 7 (18%) of 38 ankles. No fractures were displaced during treatment, and no radiographs had >1 mm of new bone formation visible.	4
46. Endele D, Jung C, Bauer G, Mauch F. Value of MRI in diagnosing injuries after ankle sprains in children. <i>Foot Ankle Int.</i> 2012;33(12):1063-1068.	Observational-Dx	30 children	To determine value of MRI in diagnosing injuries after ankle sprains in children.	Altogether, torn ligaments could be verified in 23/30 of the cases; bony avulsions were found in 10% of these. 3/30 patients had a Salter I injury. Bone bruising was found in 18/30 (60%). Bone bruising was most commonly found near the medial talus. MRI examination of the patients in Group I showed no more ruptures than the clinical examination; here, only 4 patients were found to have partial ruptures of the), anterior talofibular ligament. In Group II, torn ligaments were found in 6/12 (50%) of the cases; similarly, Salter I injuries were found in 3/12 cases. The patients in Group III also showed serious injuries on the MRI examination. Bone bruising, torn ligaments, or bony avulsions were found in 8/8 (100%) cases. The recorded clinical results showed only weak correlation to the injury patterns diagnosed using MRI. Only the bone bruises correlated with clinical results. Children with more pronounced swelling and less ability to walk were more commonly diagnosed with bone bruises. No differences were found between groups with regard to pain, instability, or limitations of mobility in the follow-up examinations or the final MRI examination 8 months after injury.	2
47. Bohay DR, Manoli A, 2nd. Occult fractures following subtalar joint injuries. <i>Foot Ankle Int.</i> 1996;17(3):164-169.	Review/Other-Dx	4 patients	A report on 4 cases of suspected joint dislocation or subluxation with occult intra-articular fractures identified only by CT scan following essentially normal radiographs.	Evidence seems to indicate that CT scanning in patients with suspected subtalar joint subluxation or dislocation and normal radiographs is justified.	4

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
48. Burton T, Sloan J. Comminuted fracture of the talus not visible on the initial radiograph. <i>Emerg Med J.</i> 2003;20(1):E1.	Review/Other-Dx	1 patient	A case is presented of a patient with a comminuted fracture of the body of the talus with nondiagnostic initial standard ankle radiographs.	Accident and emergency doctors should be aware of this injury, and be suspicious that patients with an appropriate mechanism of injury and pronounced pain may require further investigation despite normal standard ankle radiographs, as an occult fracture of the talus may be present.	4
49. Rodop O, Mahirogullari M, Akyuz M, Sonmez G, Turgut H, Kuskucu M. Missed talar neck fractures in ankle distortions. <i>Acta Orthop Traumatol Turc.</i> 2010;44(5):392-396.	Review/Other-Dx	8 patients	To evaluate the follow-up and treatment outcomes of subjects with missed fractures, which were not diagnosed with radiographs obtained for ankle distortion, but with advanced imaging studies.	The talar neck fracture was diagnosed with CT in 1 patient and with MRI in the remaining 7 patients. Mean follow-up time was 6 months (range 3-8 months), and mean American Orthopedic Foot and Ankle Society score at last follow-up was 93.7 (range 80-100).	4
50. Choi CH, Ogilvie-Harris DJ. Occult osteochondral fractures of the subtalar joint: a review of 10 patients. <i>J Foot Ankle Surg.</i> 2002;41(1):40-43.	Review/Other-Dx	10 patients	To report a series of patients with occult injuries to the subtalar joint that occurred without dislocation.	9 osteochondral fractures involved the posterior facet. 7 patients had a stiff and painful subtalar joint, and an arthrodesis was performed. 3 patients presented with adequate subtalar joint motion and were treated with physiotherapy. Detection of osteochondral fractures of the subtalar joint is difficult. The "early warning" signs are massive swelling without definitive bone injury on radiographic examination, and a failure to regain subtalar motion after a period of immobilization. Confirmatory evidence is obtained from CT scans or MRI. Initially, aggressive physiotherapy should be considered. Arthrodesis should be used for patients who remain symptomatic.	4
51. Frankel J, Turf R, Miller GA. Occult fractures of the talus. <i>J Foot Surg.</i> 1992;31(6):538-543.	Review/Other-Dx	1 patient	A case presentation of a severe ankle sprain in which the patient was nonresponsive to routine therapies is presented.	No results stated in abstract.	4
52. Mickel TJ, Andersen R, Keeling J, McKenna P. Occult talar neck fracture associated with talar avulsion diagnosed by MRI: a case report. <i>Foot Ankle Int.</i> 2008;29(9):956-958.	Review/Other-Dx	1 patient	A case presentation of a nondisplaced (Hawkins I) fracture of the talar neck not visible on radiograph and CT.	MRI was found to be a very useful diagnostic tool in the patient with an occult Hawkins I fracture of the talar neck. MRI was able to diagnose this injury and provide therapy to prevent progression to an injury with a much worse prognosis.	4
53. Boon AJ, Smith J, Laskowski ER. Snowboarding injuries: general patterns, with a focus on talus fractures. <i>Phys Sportsmed.</i> 1999;27(4):94-104.	Review/Other-Dx	N/A	To review general patterns of snowboarding injuries, with a focus on talus fractures.	No results stated in abstract.	4

Acute Trauma to the Ankle
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
54. Judd DB, Kim DH. Foot fractures frequently misdiagnosed as ankle sprains. <i>Am Fam Physician.</i> 2002;66(5):785-794.	Review/Other-Dx	N/A	To review foot fractures which are frequently misdiagnosed as ankle sprains.	CT scans or MRI may be required because these fractures are difficult to detect on plain films.	4
55. von Knoch F, Reckord U, von Knoch M, Sommer C. Fracture of the lateral process of the talus in snowboarders. <i>J Bone Joint Surg Br.</i> 2007;89(6):772-777.	Review/Other-Dx	23 snowboarders	To investigate the clinical and radiological outcome after unilateral fracture of the lateral process of the talus in snowboarders with a mean follow-up of 3.5 years (12 to 76 months).	The nonoperative group of 7 with a minimally-displaced fracture scored higher (98 points) than the operative group of 16 with displaced or unstable fractures (93 points). In 88% of operative cases, significant concomitant hindfoot injuries were found at operation. All but 8 (35%) patients (6 operative and 2 nonoperative) regained their pre-injury level of sporting activity. Subtalar osteoarthritis was present in 9 (45%) of the 20 patients available for radiological review, including 1 late-diagnosed nonoperative case and 8 operative cases with associated injuries or fracture comminution. The outcome after fracture of the lateral process of the talus in snowboarders is favorable provided an early diagnosis is made and adequate treatment, which is related to the degree of displacement and associated injuries, is undertaken.	4
56. Valderrabano V, Perren T, Ryf C, Rillmann P, Hintermann B. Snowboarder's talus fracture: treatment outcome of 20 cases after 3.5 years. <i>Am J Sports Med.</i> 2005;33(6):871-880.	Observational-Tx	20 patients	The authors recorded details of the treatment and evaluation of patients who sustained a lateral process of the talus fracture while snowboarding. The injury pathomechanism was documented.	The injury mechanism included axial impact (100%), dorsiflexion (95%), external rotation (80%), and eversion (45%). Using the American Orthopaedic Foot and Ankle Society hindfoot score, the patients obtained a mean of 93 points; the surgically treated group (n = 14) scored higher (97 points) than did the nonoperative group (n = 6; 85 points) (P<.05). Degenerative disease of the subtalar joint was found in 3 patients (15%; operative, 1 patient; nonoperative, 2 patients). All but 4 (20%, all after nonsurgical treatment) patients reached the same sport activity level as before injury.	2

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
57. Saxena A, Eakin C. Articular talar injuries in athletes: results of microfracture and autogenous bone graft. <i>Am J Sports Med.</i> 2007;35(10):1680-1687.	Review/Other-Tx	26 microfracture procedures and 20 bone grafts to the talus	To assess treatment options of talar osteochondral lesions.	There were 26 microfracture procedures and 20 bone grafts to the talus. The AOFAS scores for both microfracture (preoperative, 54.6; postoperative, 94.4) and bone graft (preoperative, 46.1; postoperative, 93.4) patients improved significantly. The RTA for the entire group was 17.0 +/- 5.3 weeks; for those undergoing microfracture, RTA was 15.1 +/- 4.0 weeks; and for bone grafting, it was 19.6 +/- 5.9 weeks. The RTA for the bone graft group was significantly slower than that of the microfracture group. Anterolateral lesions had significantly faster RTA and higher postoperative scores compared with other lesion locations. Arthroscopically treated lesions had similar postoperative AOFAS scores to those who had arthrotomy and did not have significantly faster RTA. 44 (96%) "excellent/good" AOFAS scores were achieved overall for talar lesions, with the same percentage of return to sport.	4
58. Cronier P, Talha A, Massin P. Central talar fractures--therapeutic considerations. <i>Injury.</i> 2004;35 Suppl 2:SB10-22.	Review/Other-Dx	N/A	To lead the surgeon who has to treat talar fractures to reflect on the goals of the treatment and the means to success.	No results stated in abstract.	4
59. Boack DH, Manegold S. Peripheral talar fractures. <i>Injury.</i> 2004;35 Suppl 2:SB23-35.	Review/Other-Dx	N/A	A review on peripheral fractures of the talus.	No results stated in abstract.	4

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
60. Leontaritis N, Hinojosa L, Panchbhavi VK. Arthroscopically detected intra-articular lesions associated with acute ankle fractures. <i>J Bone Joint Surg Am.</i> 2009;91(2):333-339.	Review/Other-Dx	283 ankle fractures	To determine if the severity of an acute ankle fracture is correlated with an increased number of arthroscopically detected intra-articular chondral lesions.	Of the 283 patients, 84 (44 female and 40 male) met our inclusion criteria. Chondral lesions were found in 61 patients (73%). Of 17 fractures graded as pronation-external rotation or supination-external rotation type I according to the Lauge-Hansen classification, 15 were associated with one or no chondral lesion and two, with two or more chondral lesions. Of 10 fractures graded as pronation-external rotation or supination-external rotation type II, 9 were associated with one or no chondral lesion and one, with two or more chondral lesions. Of 56 fractures graded as pronation-external rotation or supination-external rotation type IV, 27 were associated with one or no chondral lesion and 29, with two or more chondral lesions. Type-IV pronation-external rotation and supination-external rotation ankle fractures were more likely to be associated with two or more chondral lesions than type-I fractures (OR = 8.1, 95% CI, 1.7 to 38.6; P=0.0044) or type-II fractures (OR = 9.7, 95% CI, 1.1 to 81.5; P=0.0172).	4

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
61. McCollum GA, Calder JD, Longo UG, et al. Talus osteochondral bruises and defects: diagnosis and differentiation. <i>Foot Ankle Clin.</i> 2013;18(1):35-47.	Review/Other-Dx	N/A	To review the available literature and concentrates on the diagnosis, prognosis, and management of posttraumatic ankle bone bruising and on differentiating the lesion from an OCD of the talus.	Acute bone bruises of the talus after ankle injury are common. They need to be differentiated from OCDs because their management is different. Bone bruises have a benign course, with clinical resolution in 6 to 8 weeks, but MRI may show persistent edema for 6 to 12 months. The presence of a bone bruise should not delay rehabilitation unless symptoms persist or significant edema is close to the subchondral plate and do not cause ankle dysfunction. OCDs are essentially a fracture of the cartilage and underlying subchondral bone plate. They have a less predictable prognosis, and rehabilitation should aim at promoting healing of the fracture to avoid long-term symptoms, complications, and propagation of the lesion. A period of nonweight bearing, maintaining strength and range of motion, reduces the cyclical pressure load through the fissure and promotes healing. Surgery should be reserved for chronic symptomatic lesions (3 months after injury) or for those patients undergoing lateral ligament reconstruction in whom arthroscopic assessment is indicated.	4
62. Langner I, Frank M, Kuehn JP, et al. Acute inversion injury of the ankle without radiological abnormalities: assessment with high-field MR imaging and correlation of findings with clinical outcome. <i>Skeletal Radiol.</i> 2011;40(4):423-430.	Observational-Dx	38 patients	To correlate prospectively the findings of high-field 3 T MRI in acute ankle distortion with clinical outcome.	In 24/38 patients (63.12%), ligament injury was observed. In 22/24 cases, this was an injury of the lateral ligaments and in 2/24 cases of the medial ligaments. Injury of the syndesmosis occurred in three patients, a bone bruise in four, and an osteochondral lesion in three cases. Patients with an injury of two or more ligaments or a bone bruise had a lower AOFAS score and returned to sports activities and full weight-bearing later ($P<0.01$).	2

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
63. Griffith JF, Lau DT, Yeung DK, Wong MW. High-resolution MR imaging of talar osteochondral lesions with new classification. <i>Skeletal Radiol.</i> 2012;41(4):387-399.	Observational-Dx	70 patients	Retrospective review of high-resolution MRI features of talar dome osteochondral lesions and development of new classification system based on these features.	Microscopy coil imaging at 1.5 T yielded 20% better signal-to-noise characteristics than ankle coil imaging at 3 T. High-resolution MRI revealed that osteochondral junction separation, due to focal collapse of the subchondral bone, was a common feature, being present in 28 (45%) of 61 medial central osteochondral lesions. Reparative cartilage hypertrophy and bone: bone separation in the absence of cartilage fracture was also common findings. Complete osteochondral separation was uncommon. A new 5-part grading system incorporating features revealed by high-resolution MRI was developed.	3
64. McCollum GA, van den Bekerom MP, Kerkhoffs GM, Calder JD, van Dijk CN. Syndesmosis and deltoid ligament injuries in the athlete. <i>Knee Surg Sports Traumatol Arthrosc.</i> 2013;21(6):1328-1337.	Review/Other-Dx	N/A	To review both syndesmotic and deltoid ligament injuries without fracture in the professional athlete.	The incidence of syndesmotic injury ranges from 1% to 18% of ankle sprains. This may be underreported and is an often missed injury as clinical examination is generally not specific. Both MRI and ultrasonography have high sensitivities and specificities in diagnosing injury. Arthroscopy may confirm the diagnosis, and associated intra-articular pathology can be treated at the same time as surgical stabilization. Significant deltoid ligament injury in isolation is rare, there is usually associated trauma. Major disruption of both deep and superficial parts can lead to ankle dysfunction. Repair of the ligament following ankle fracture is not necessary, but there is little literature to guide the management of deltoid ruptures in isolation or in association with syndesmotic and lateral ligament injuries in the professional athlete.	4

**Acute Trauma to the Ankle
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
65. Hermans JJ, Wentink N, Beumer A, et al. Correlation between radiological assessment of acute ankle fractures and syndesmotic injury on MRI. <i>Skeletal Radiol.</i> 2012;41(7):787-801.	Observational-Dx	51 patients	To correlate 3 common clinical fracture classification systems with MRI findings, regarding injury of the syndesmosis in acute ankle fractures. Secondary goals were to determine the correlation between the radiographic measurements and fracture treatment in relation to syndesmotic injury.	The Weber and AO-Müller fracture classification system, in combination with additional measurements, detected syndesmotic injury with a sensitivity of 47% and a specificity of 100%, and Lauge-Hansen with both a sensitivity and a specificity of 92%. tibiofibular clear space, tibiofibular overlap and did not correlate with syndesmotic injury, and a widened medial clear space did not correlate with deltoid ligament injury.	2
66. Taweel NR, Raikin SM, Karanjia HN, Ahmad J. The proximal fibula should be examined in all patients with ankle injury: a case series of missed maisonneuve fractures. <i>J Emerg Med.</i> 2013;44(2):e251-255.	Review/Other-Tx	5 patients	A case study to show the ease of missing the proximal fibular fracture when the clinical examination is directed to the ankle region and to discuss the importance of palpating the proximal fibula and ordering appropriate radiographs.	The Maisonneuve fracture injury pattern causes untoward consequences if not promptly recognized and treated. To avoid misdiagnosis, the proximal fibula should be examined in all patients with ankle injury.	4

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

CI = Confidence interval

CT = Computed tomography

MDCT = Multidetector computed tomography

MRI = Magnetic resonance imaging

OAR = Ottawa ankle rules

OR = Odds ratio

PPV = Positive predictive value

ROC = Receiver-operator characteristic