

PRACTICAL SUMMARIES IN ACUTE CARE

A Focused Topical Review of the Literature for the Acute Care Practitioner

Management of Ankle Injuries: An Update

Author: **Moira Davenport, DO**, Attending Physician, Department of Emergency Medicine and Orthopedic Surgery, Allegheny General Hospital, Drexel University School of Medicine, Pittsburgh, PA.

Peer Reviewer: **Gary Hals, MD, PhD**, Attending Physician, Department of Emergency Medicine, Palmetto Health Richland Hospital, Columbia, SC.

Introduction

ANKLE INJURIES ARGUABLY ARE among the most common musculoskeletal conditions seen in the acute care setting, with current estimates suggesting that 23,000 ankle sprains occur daily in the United States,¹ accounting for 1.6 million physician visits per year.² This may actually be an underestimate of the true incidence of ankle injury, as many people sustaining ankle injuries don't seek medical treatment and many seek treatment from non-hospital-based providers (e.g., athletic trainers, physical therapists). As more people turn to exercise to counter the obesity epidemic, acute care physicians can expect to continue to see ankle injuries. This increase in activity is confounded by the fact that obesity has been found to be a risk factor for ankle sprains.³ Multiple studies report ankle injury rates as high as 30% among all athletes, with 79% of basketball players and 82% of volleyball players

experiencing ankle injuries in their careers.⁴

A brief review of ankle anatomy and function can help explain injury patterns. The syndesmosis (or true ankle) is the joint formed by the tibiofibular articulation with the talus. Syndesmotic ligaments include the anterior and posterior tibiofibular ligaments and the interosseous membrane. This joint serves only to plantar flex and dorsiflex the foot; all other motion occurs at the subtalar joint.

The lateral aspect of the ankle is supported by the anterior talofibular ligament (ATFL), calcaneofibular ligament, and posterior talofibular ligament. This complex is not particularly strong, and is thus likely to be injured. The deltoid ligament forms the medial support for the ankle and is considerably stronger than its lateral counterpart. Due to the geometry of the talus, the ankle joint is most unstable in plantar flexion; the lateral ligaments are also

stretched and most lax at this time, leading to a higher prevalence of lateral ligamentous injuries.

Ankle injuries are not as innocuous as commonly believed; in fact, patients may experience pain up to 18 months after the initial injury. Physical therapy is recommended for all but the most minor of injuries. The acute care practitioner can have a particular impact on patient education in these regards; it is suggested that the acute care physician relay this information to the patient to maximize patient recovery and limit early return visits to the acute care setting.

Persistent pain and reinjury are not at all uncommon and account for a significant number of recurrent patient visits to acute care practitioners.⁵ Patients who present with continued pain 4–6 months after the injury despite a course of physical therapy should be re-evaluated. Consideration

VOLUME 4 • NUMBER 5 • MAY 2009 • PAGES 33-40
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Statement of Financial Disclosure: Executive Editor, Ann M. Dietrich, MD, FAAP, FACEP; Dr. Davenport (author); and Dr. Hals (peer reviewer) reported no financial relationships with companies having ties to this field of study.

should be given to diagnoses other than simple ankle sprain, including (but not limited to) peroneal tendon subluxation or dislocation (sliding of the tendons over the lateral malleolus, particularly with attempts at eversion), osteochondritis dissecans (disruption of articular cartilage with underlying

bony abnormalities), posterior ankle impingement syndrome (pain along the posterior aspect of the ankle, particularly with the foot in plantar flexion and plantar flexion with axial loading), subtalar subluxation, and talar stress fractures. Patients in whom these conditions are suspected should be referred to orthopedic surgeons or sports medicine physicians for further evaluation and advanced imaging, preferably magnetic resonance imaging (MRI).

Functional Bracing vs. Splint in Ankle Injuries

Sources: Kerkhoffs GM, Rowe BH, Assendelft WJ, et al. Immobilisation and functional treatment for acute lateral ankle ligament injuries in adults.

Cochrane Database Syst Rev 2002;3: CD003762; Kerkhoffs GM, Struijs PA, Marti RK, et al. Different functional treatment strategies for acute lateral ankle ligament injuries in adults.

Cochrane Database Syst Rev 2002;3: CD002938.

KERKHOFFS AND COLLEAGUES performed a review of treatment modalities for lateral ankle sprains for Cochrane Database. They included 21 trials with 2,184 subjects enrolled. Results showed that those treated with functional bracing (elastic bandage, soft cast/stirrup, lace-up orthotic, or tape) fared significantly better than those placed in a plaster/fiberglass splint. Outcome measures reported:

- Higher rate of long-term return to original activity/sport;
- Decreased time to return to sport;
- More rapid short-term return to work;
- Less persistent edema on short-term follow-up; and
- Higher overall satisfaction.

Kerkhoffs and colleagues completed a second Cochrane review comparing the efficacy of the various functional treatment options available (and previously mentioned). Nine studies with 892 subjects were included, and they found that lace-up orthotics users had:

- Less persistent edema;
- Shorter time to return to work;
- Shorter time to return to sport;
- Less instability at short-term follow-up.

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Practical Summaries in Acute Care, ISSN 1930-1103, is published monthly by AHC Media LLC, 3525 Piedmont Rd., NE, Bldg. 6, Suite 400, Atlanta, GA 30305.

ASSOCIATE PUBLISHER: Coles McKagen

MANAGING EDITOR: Allison Weaver

DIRECTOR OF MARKETING: Schandale Komegaw

GST Registration Number: R128870672.

Periodicals Postage Paid at Atlanta, GA 30304 and at additional mailing offices

POSTMASTER: Send address changes to *Practical Summaries in Acute Care*, P.O. Box 740059, Atlanta, GA 30374.

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Plotting the Clinical Course of Acute Ankle Sprains

Source: vanRijn RM, vanOs AG, Bernsen RM, et al. What is the clinical course of acute ankle sprains? A systematic literature review. *Am J Med* 2008;121:324-331.

VANRIJN AND COLLEAGUES performed a literature review to better delineate the clinical course of ankle sprains. A total of 31 studies were found, and 24 were suitable for inclusion. While pain decreased significantly in the two weeks following the original injury, up to 33% of patients still had pain at one year. As many as 34% of patients suffered a repeat sprain, and 33% had recurrent instability without frank reinjury.

Commentary

This study reinforces the recurrent nature of ankle injuries and emphasizes the need for patient education in the emergency department (ED) regarding the average time needed for recovery from ankle sprains. The review also highlights the need for well designed studies on the topic of ankle injury.

Commentary

Kerkhoff's first study delineated the need for acute care physicians to discharge ankle injury patients with functional braces and to emphasize the need to ambulate as early as tolerated. The authors also highlight difficulties encountered with several popular treatment modalities.

It is important to note that it is relatively difficult to properly apply an elastic bandage. Uneven surfaces in the applied bandage can result in skin ulceration, further complicating the recovery. Plantar ulcerations and blisters make the early return to weight-bearing somewhat difficult. Once the bandage is applied, it is also somewhat challenging to get the bandage to stay in place, particularly as the patient begins to ambulate. Along similar lines, it is somewhat challenging for patients to properly tape an ankle. Again, significant skin damage can occur if proper underwrap is not used and if wrinkles or bulges are present in the finished product. Finally, once tape is applied it starts to lose its elastic support within 10 minutes of application, thus rapidly losing therapeutic benefit.

Although the data in Kerkhoff's study comparing treatment options are helpful, the study is limited by several factors, notably that it included mostly small, non-randomized studies whose subjects had inconsistent follow-up. Furthermore, subjects underwent non-standardized physical therapy regimens which may also bias results slightly. This review further highlights the need for well-designed studies on the topic of ankle injuries.

Elastic Bandage vs. Aircast for Treatment of Inversion Injury

Source: Boyce SH, Quigley MA, Campbell S. Management of ankle sprains: A randomized controlled trial of the treatment of inversion injuries using an elastic support bandage or an Aircast ankle brace. *Br J Sports Med* 2005;39:91-96.

BOYCE AND COLLEAGUES designed a prospective randomized study to evaluate the efficacy of elastic bandages compared with Aircast (DJO LLC, Vista, CA) for treating lateral ankle sprains. A total of 52 consecutive patients were enrolled and all received standard discharge instructions in addition to the study treatment. Follow-up assessments were made at 2-3 days, 10 days, and one month post injury. Patients receiving the Aircast had significantly better ankle function than those using the elastic bandage.

Commentary

This study is prospective and randomized; however, the power is not ideal. Bias is limited in that all subjects received the same discharge instructions. The study does begin to reinforce the trends identified in the earlier review by Kerkhoffs.

First-time Sprains: Comparison of Treatment Options

Source: Beynnon BD, Renstrom PA, Haugh L, et al. A prospective, randomized clinical investigation of the treatment of first-time ankle sprains. *Am J Sports Med* 2006;34:1401-1412.

BEYNNON AND COLLEAGUES FIRST clinically classified ankle sprain patients by severity of the injury (using the Bergfeld scale), and then within each group prospectively randomized patients by treatment modality. Grade I sprain patients (partial tear of the ATFL) were randomized into treatment

with air stirrups, elastic wrap, or the two methods combined. Grade II patients (completely torn ATFL +/- partial calcaneofibular ligament tear) were randomized between treatment with the stirrup brace, the stirrup/elastic wrap, or a fiberglass walking cast. Grade III tears (complete tears of all three lateral ligaments) were treated with air stirrup or fiberglass walking cast. A total of 1,310 patients were eligible to participate. Final study groups included 64 patients with Grade I injuries (52 completing the study protocol), 116 with Grade II tears (93 with complete data sets), and 32 with Grade III injuries (27 completing the protocol). All subjects underwent the same home therapy program. Patients completed a log measuring pain and function.

The authors found that Grade I patients treated with both modalities returned to normal walking in half the time of the other means. Grade II patients treated with the combination therapy also did significantly better than other treatment groups. Grade III patients noted no difference between treatment methods.

Commentary

The authors highlight the different treatment methods available for those suffering ankle inversion injuries. However, several aspects of the study deserve mention. First, the authors had significantly fewer subjects than the total number of eligible patients; this introduces a moderate amount of bias into the results. Second, the classification of ankle injuries on a strictly clinical basis is somewhat difficult (although the authors did assess internal validity with a subset of 20 patients) and is now not widely used. Treatment bias was again limited by the fact that patients in all groups received the

same discharge instructions. Finally, the study was funded in part by the maker of the air stirrup, again introducing bias into the results.

Lack of Discharge Instruction Common

Source: Chorley JN. Ankle sprain discharge instructions from the emergency department. *Pediatr Emerg Care* 2005; 21:498–501.

CHORLEY AND COLLEAGUES PERFORMED a retrospective chart review to evaluate the type of discharge instructions given to ankle sprain patients. A total of 374 charts were studied, and instructions given varied significantly:

- Analgesics—85%
- Rest—72%
- Ice—41%
- Compression—43%
- Elevation—55%
- ROM exercises—5%
- Strengthening exercises—1%
- Proprioceptive exercises—0.3%

Commentary

The mnemonic RICE (rest, ice, compression and elevation) is commonly recommended for treatment of musculoskeletal injuries. This study reveals that even these basic components are not recommended to acute care patients on a regular basis. It is reassuring, however, to see that a predominance of patients were advised to use analgesics. However, essentially no patients were advised to start basic therapy exercises.

Given that recurrent sprains and/or chronic instability are indicative of greater need for physical therapy, omitting this aspect of discharge instructions may ultimately result in repeat ankle sprains and more visits to the ED.

Are Ankle Orthoses Useful in Preventing Sprains?

Source: Mohammadi F. Comparison of 3 preventive methods to reduce the recurrence of ankle inversion sprains in male soccer players. *Am J Sports Med* 2007;35:922–926.

MOHAMMADI EXAMINED 80 national-caliber soccer players who were recovering from ankle inversion injury. Players were randomly divided into four groups of 20: control group (no therapy), proprioceptive training, strength training, and orthosis only. Players in all study groups sustained fewer recurrent injuries than those in the control group, although the results were only significant for the proprioception training group.

Commentary

This study augments the argument that acute care physicians should be advising patients to perform basic rehabilitative exercises. Although subjects in this study had physical therapists and appropriate materials readily available to them, patients seen in the ED can easily adapt the exercises. Proprioception can start with the patient simply standing on the injured leg (supporting self with a wall or furniture to start) and progressing to standing on one leg with the eyes closed. Towels can be substituted for resistance bands to begin the home therapy process, and patients can be advised to place the toes on the floor and draw the letters of the alphabet without picking up the toes; this exercise will get the ankle and subtalar joints moving through the normal ranges of motion. Lace-up orthosis prescriptions can be provided to patients upon dis-

charge from the ED. Combining the results of these studies, the current recommendations are to discharge patients with ankle stirrup devices, a prescription for a lace-up orthosis, and a basic knowledge of early rehabilitative exercises.

Interventions to Prevent Ankle Injuries

Source: Handoll HH, Rowe BH, Quinn KM, et al. Interventions for preventing ankle ligament injuries. *Cochrane Database Syst Rev* 2001;3:CD000018.

HANDOLL AND COLLEAGUES updated a previous Cochrane Database Review assessing the role and efficacy of air stirrup and lace up orthoses in preventing ankle sprains. A total of 14 studies were included (nine additional studies from the original review) with 8,279 subjects. Protective measures studied included semi-rigid ankle braces, air stirrups, high-top sneakers, proprioceptive training, and taping.

There was a significant reduction in the number of ankle sprains in those using the air stirrup, the semi-rigid brace and the lace-up orthoses. The difference was particularly noticeable in those with previous ankle injuries. The role of high-top sneakers in preventing ankle injuries was not clearly demonstrated.

Commentary

This study further advances the role of ankle orthoses in preventing injury, particularly recurrent injury. It also highlights the availability of activity appropriate orthoses. Again, the variable methodology of the included studies should be mentioned as a weakness of the review.

Tramadol vs. Hydrocodone for Ankle Sprain Pain

Source: Hewitt DJ, Todd KH, Xiang J, et al. Tramadol/acetaminophen or hydrocodone/acetaminophen for the treatment of ankle sprain: A randomized, placebo-controlled trial. *Ann Emerg Med* 2007;49:468–480.

THIS RANDOMIZED, MULTI-centered study examined the efficacy of tramadol/acetaminophen versus hydrocodone/acetaminophen for the treatment of pain associated with acute ankle sprains. Patients were discharged with the medication and advised to take 1–2 tabs every six hours as needed. Adult subjects recorded hourly pain scores for the first four hours after injury and then daily for the next five days. A repeat visit occurred on day six. Patients in both study groups had significantly greater reduction in pain than those in the placebo group, but no significant differences were found between the two analgesics. Somnolence, nausea, dizziness, and vomiting were common in both treatment groups; 40% in the tramadol group and 19% in the hydrocodone group reported a reaction of some type.

Commentary

This study is well powered and blinded, but several flaws do exist. First, the study is funded by the pharmaceutical industry, which may bias results. Secondly, subjects were paid to complete the study protocol, which also may affect results. The study fails to mention what other interventions patients may have been using (bracing, physical therapy), and thus has not satisfactorily addressed possible confounding variables. Lastly, pain is assessed at

rest throughout the study, which may overestimate the efficacy of pain relief. It would have been helpful for the authors to also assess pain with return to basic activity to better mimic clinical conditions. The study does highlight the tramadol option for acute pain relief; this agent may be a welcome choice for those unable to take NSAIDs or opioid-based analgesics.

Balance Training to Reduce Ankle Injury Risk

Source: McHugh MP, Tyler TF, Mirabella MR, et al. The effectiveness of a balance training intervention in reducing the incidence of noncontact ankle sprains in high school football players. *Am J Sports Med* 2007;35:1289–1294.

PLAYERS FROM TWO HIGH SCHOOL football teams were divided into two groups based on the risk of ankle injury. High-risk players were defined as those with previous ankle injuries and those with high body mass indices (BMI). High risk players underwent proprioceptive training (five minutes per leg, five days per week pre-season and two days per week in season), while other risk groups simply followed basic practice schedules. There was a significant reduction in injuries among the high risk group; this decrease was not seen in the control group.

Commentary

This study also highlights the benefit of proprioceptive training in decreasing the incidence of ankle sprains. However, this study did not account for several confounding variables, including the use of lace-up orthotics following the initial injury, the type of shoe

worn for football, and the use of tape or spitting (tape outside the shoe). Additional strength is given to the study by the fact that the same athletes were followed throughout the course of the three-year study and the athletes had the same medical staff throughout the study period.

Validation of Refined Ottawa Foot and Ankle Rules

Source: Stiell IG, Greenberg GH, McKnight RD, et al. Decision rules for the use of radiography in acute ankle injuries. Refinement and prospective validation. *JAMA* 1993;269:1127–1132.

STIELL AND COLLEAGUES REFINED clinical decision rules they previously developed. The second phase was to validate the redefined rules. To accomplish these goals, a convenience sample of ankle sprain patients were enrolled; 1,032 (of 1,130 eligible patients) were included in the first step and 453 of 530 eligible subjects completed the second stage of the study. The decision rules were found to have a sensitivity of 1.0 for detecting malleolar fractures and 0.98 for detecting mid-foot fractures. Following revision of the rules, the second stage determined their sensitivity to identify both malleolar area and forefoot fractures to be 1.0. The authors found that by using the refined rules, the number of ankle x-rays could be reduced by 34% and the number of foot x-rays were decreased by 30%.

Commentary

This paper by Stiell et al is one of the most quoted in evidence based medicine. This redefined the Ottawa foot and ankle rules, establishing them as commonly used today. If the following conditions

are met, x-rays are not warranted:

- No tenderness to palpation over the distal 6 cm of the tibia and fibula;
- No tenderness to palpation over the base of the fifth metatarsal;
- No tenderness to palpation over the navicular;
- The patient was able to walk four steps both at the time of the injury and in the ED.

The few weakness of the study do deserve mention. The fact that a convenience sample of patients was used does raise the issue of slight bias. The power of the second arm of the study has been questioned, as well. However, this paper continues to be used as an example of evidence-based medicine that should be performed, studied, and implemented.

Are Ottawa Rules Accurate in Children?

Source: 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. *Acad Emerg Med* 2009;(e-pub ahead of print).

THE AUTHORS PERFORMED AN extensive literature search to evaluate the sensitivity and specificity of the Ottawa Ankle Rules in a pediatric population aged 5-17 years. (It should be noted that the original Ottawa Ankle Rules were validated in patients over the age of 18.) A total of 12 studies (3,130 patients) were included. There was a total of 671 fractures, 661 of which would have been detected using the clinical decision rule. The missed fractures included two small avulsion fractures, one Salter Harris (SH) I injury, and one SH IV injury; the other missed fractures were not clearly defined. The calculated sen-

sitivity was 98.5 and the authors determined that using the Ottawa Ankle Rules in this population would have decreased the number of x-rays performed by 24.8%

Commentary

The initial clinical decision rule study did not enroll pediatric patients due to the complexity of the open physis. This study attempts to apply the Ottawa Ankle Rules to the pediatric population not previously studied. The variable designs of the studies included in this retrospective paper weaken the reported results. The fact that one of the missed fractures was a SH IV injury is concerning, given the long-term growth consequences that can be associated with missing this fracture. Although this study does imply that the OAR can be used in children, further studies, particularly prospective evaluations, are required.

Ottawa Ankle Rules Hard to Implement

Source: Holroyd BR, Wilson D, Rowe BH, et al. Uptake of validated clinical practice guidelines: Experience with implementing the Ottawa Ankle Rules. *Am J Emerg Med* 2004;22:149-155.

HOLROYD AND COLLEAGUES PERformed a prospective cohort study to determine if a formal educational program would increase physician compliance with the Ottawa Ankle Rules. The study occurred over two years at four hospitals, two serving as controls and two as the study groups. All physicians at the four hospitals were given a paper copy of the Ottawa Ankle Rules prior to the beginning of the study. Intervention groups then received directed education aimed at increasing use of the clinical decision rule. Medical

records of all patients presenting with ankle injuries were evaluated to determine the number of x-rays performed and if the Ottawa Ankle Rules were used. The authors found that there was no difference between groups in terms of the number of x-rays performed.

Commentary

This study highlights the difficulty in fully implementing the Ottawa Ankle Rules. Despite specific educational interventions, there is still some role of personal experience and clinical judgment in the evaluation of the ankle injured patient. The authors also discuss other interventions that may increase compliance with the decision rule.

Complete Ankle Rule Compliance Elusive

Source: Leisey J. Prospective validation of the Ottawa Ankle Rules in a deployed military population. *Mil Med* 2004;169:804-806.

LEISEY PERFORMED A PROSPECTIVE study of 45 active duty military personnel with ankle injuries. The treating physician documented the Ottawa Ankle Rules for each patient; the decision to x-ray the patient was left up to the physician. All x-rays were formally read by a radiologist with no knowledge of the patient presentation. Twenty-nine patients met the Ottawa Ankle Rules criteria, while 32 patients had radiographs performed. A total of five fractures were found, all of which were identified by the Ottawa Ankle Rules. The sensitivity of the Ottawa Ankle Rules was calculated to be 1.0 and the specificity 0.4.

Commentary

This study echoes the findings of

Holroyd et al that complete compliance with the Ottawa Ankle Rules is difficult to achieve. The small study size does limit its application to the general hospital setting. Also, it is difficult to apply the results of this study to the general hospital population as the limited patient diversity of a military hospital may further affect the results.

Nurses' Use of Ottawa Rules Speeds Triage

Source: 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. *Am J Emerg Med* 2005;23:725-729.

THIS PROSPECTIVE STUDY WAS designed to determine if emergency nurses could apply the Ottawa Ankle Rules to patients in triage. All nurses underwent a basic educational program to familiarize them with the Ottawa Ankle Rules. Patients presenting to the ED were evaluated by either a trained nurse or a junior level resident. All patients in the study had x-rays performed. The ability of the two groups to detect fractures was calculated. Both groups were able to detect significant injury with a sensitivity of 0.93. The sensitivity was 0.49 for the nurses and 0.39 for the junior level residents.

Commentary

Although this study is small, it does show that the Ottawa Ankle Rules can be applied appropriately with minimal training. This could have a significant impact on emergency care, as earlier application of the rules could decrease the number of x-rays performed and, through the use of protocols, could decrease the time waiting for x-rays.

Alternate Diagnoses in Patients with Persistent Ankle Pain

Source: Ebraheim NA, Patil V, Frisch NC, et al. Diagnosis of medial tubercle fractures of the talar posterior process using oblique views. *Injury* 2007;38:1313-1317.

THIS CADAVERIC STUDY WAS designed to highlight the need to consider alternate diagnoses in the patient with persistent ankle pain, particularly those who sustained injury with the foot dorsiflexed and pronated. The study limbs all had fractures induced to the posteromedial talar tubercle and then underwent routine ankle x-rays with additional views in 450 and 700 of external rotation. The fractures were not seen on the routine series but were easily visualized on the external rotation views.

Commentary

The examination of the acutely injured ankle may be limited by general edema and the lack of a localized area of tenderness; these factors, combined with the fact that patients are often unable to recall the position of the ankle at the time

of injury, may limit the physician's suspicion for this injury initially. However, this should be suspected on repeat visits to the ED, particularly when there is tenderness to the posteromedial aspect of the ankle. Including the views mentioned in this study may obviate the need for computed tomography (CT) scan or MRI to adequately evaluate this injury.

Conclusions

Ankle injuries are among the most common musculoskeletal injuries encountered in the acute care setting. Although the literature is of questionable methodologic design, several trends have been identified. Patients have a more rapid decrease in pain and a more rapid return to activity when discharged with an air stirrup brace. Adequate analgesics should also be recommended. Finally, patient education is a critical part of the acute care medical visit. Basic range of motion and proprioceptive exercises should be discussed in the acute care setting and patients advised to start the exercises as soon as tolerated. Follow-up with orthopedic surgeons or the patient's primary care provider is recommended to ensure

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a timely recovery and to facilitate referral to short-course physical therapy. Patients presenting with persistent pain despite therapy and without recurrent trauma should be referred for further advanced imaging to better delineate the extent of the injury.

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CME QUESTIONS

21. Which of the following is recommended for ankle sprain patients?

- a. Crutches
- b. Air stirrup
- c. Elastic bandage
- d. No weight bearing

22. Which of the following is best when an ankle sprain patient returns to activity?

- a. Elastic bandage
- b. High-top sneakers
- c. No protection needed
- d. Lace-up orthosis

23. In which of the following positions is the lateral ankle most unstable?

- a. Neutral
- b. Dorsiflexion
- c. Plantar flexion
- d. All positions are equally high risk

24. Derksen et al found that use of Ottawa Ankle Rules by emergency department nurses could decrease the number of x-rays performed and decrease wait time when x-rays are necessary.

- a. True
- b. False

25. Which of the following should be considered in the differential diagnosis of persistent ankle pain six months after injury despite appropriate physical therapy and no recurrent trauma?

- a. talar stress fractures
- b. osteochondritis dissecans
- c. Peroneal tendon subluxation
- d. All of the above

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Assistant Professor of Surgery, Associate Chief, Division of Emergency Medicine, Stanford University School of Medicine, Stanford, California

David E. Manthey, MD

Director, Undergraduate Medical Education, Associate Professor, Department of Emergency Medicine, Wake Forest University School of Medicine, Winston-Salem, North Carolina

Catherine Marco, MD, FACEP

Clinical Professor, Medical University of Ohio; Attending Physician, St. Vincent Mercy Medical Center, Toledo, Ohio

Amal Mattu, MD

Associate Professor and Program Director, Emergency Medicine Residency, University of Maryland School of Medicine, Baltimore, Maryland

Ronald Perkin, MD, MA

Professor and Chairman, Department of Pediatrics, The Brody School of Medicine, East Carolina University, Greenville, North Carolina

Andrew D. Perron, MD, FACEP, FACSM

Residency Program Director, Department of Emergency Medicine, Maine Medical Center, Portland, Maine

John Santamaria, MD

Affiliate Professor of Pediatrics, University of South Florida School of Medicine, Tampa, Florida

Answers: 21. b, 22. d, 23. c, 24. a, 25. d