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National Athletic Trainers' Association Position Statement: Immediate Management of Appendicular Joint Dislocations

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Objective: To provide certified athletic trainers (ATs) with recommendations and guidelines for the immediate management of patients with joint dislocations.

Background: One of the primary responsibilities of ATs is to provide immediate injury care for active individuals. Although ATs are confronted with managing patients who have many kinds of injuries, the onsite management of a joint dislocation presents challenges in evaluation and immediate treatment. The critical concern in managing a dislocation is deciding when a joint can be reduced onsite and when the patient should be splinted and transported for reduction to be performed in the hospital or medical setting. Factors that influence the decision-making process include the following: whether the AT possesses a documented protocol that is supported by his or her supervising physician(s), employer documents, and respective state regulations; the AT's qualifications and experience; the dislocated joint; whether the dislocation is first time or recurrent; the patient's age and general health; and whether associated injuries are present.

Recommendations: These guidelines are intended to provide considerations for the initial care of specific joint dislocations. They are not intended to represent the standard of care and should not be interpreted as a standard of care for therapeutic or legal discussion.

Key Words: injury care, joint luxation, joint subluxation, emergency management

Certified athletic trainers (ATs) care for a variety of musculoskeletal injuries, but one area of persistent controversy is the immediate management of patients with joint dislocations, both acute and recurrent. Therefore, the goal of this position statement is to provide ATs with recommendations for the immediate management of patients with joint dislocations. When establishing their policy for the immediate management of patients with joint dislocations, ATs must comply with their state practice regulations and take into account the predetermined protocols of their supervising physician and institution and their own training and experience in reducing the specific joint dislocation.

The decision to reduce a dislocated joint depends on a number of variables. One such variable is the amount of time the joint has been dislocated, as the longer a joint has been disarticulated, the more urgent or difficult the subsequent onsite reduction may be.[1–7] Other variables are the ease of the joint reduction,[8–13] the patient's age and general health,[2,14–19] and the presence of any concomitant injury (including fracture).[2,6,7,20–25] Especially important factors are any neurovascular compromise[7,13,20,22,23,26–31] and whether the injury represents a recurrent dislocation.[26,28]

In discussing this topic, it is necessary to understand the terminology of joint dislocations. For this paper, the following nomenclature, as adopted from *Taber's Medical Dictionary*,[32] applies. The term *dislocation* refers to the complete displacement of a bone from its normal joint position. A *subluxation* is the partial or transient displace-

ment of a bone from its normal position in a joint. An *acute dislocation* or *subluxation* refers to the first occurrence of the injury. Subsequent incidences are classified as *recurrent*. Joints that repeatedly dislocate or subluxate are considered *chronically unstable*. In this document, recommendations will focus on the management of patients with complete dislocations and will distinguish between acute and recurrent injuries.

When a joint is dislocated, the main treatment priorities are to (1) avoid neurovascular complications and (2) reduce the joint as atraumatically as possible.[33] *Reduction* refers to the realignment of the joint to its anatomical position or congruency, but onsite reduction of joint dislocations may not be warranted in all situations or appropriate for all joints. Several variables, such as the specific joint, the possibility of associated fractures, and the experience and training of the AT and other medical personnel, should be carefully considered before an onsite reduction is attempted. Through careful review of the recommendations of this position statement and discussion with pertinent medical personnel, sound protocols can be established for the immediate management of patients with joint dislocations. Therefore, the goal of this position statement is to provide ATs with recommendations for the immediate management of joint dislocations based on the available literature and expert opinions of this statement's authors. Although most, if not all, of the dozens of joints in the human body can at some time become disarticulated via many different mechanisms, this position statement will primarily cover the dislocations most commonly managed by ATs.

RECOMMENDATIONS

Based on the current literature, the National Athletic Trainers' Association (NATA) and the NATA Research & Education Foundation suggest the following guidelines for the evaluation and immediate care of patients with musculoskeletal joint dislocations. Although these guidelines and recommendations may apply to many health care professionals, our focus is on ATs.

The recommendations in this statement are supported using the Strength of Recommendation (SOR) Taxonomy system.[34] The letter indicates the consistency and evidence-based strength of the recommendation (*A* reflects the strongest evidence base). For the practicing clinician, any recommendation with an A grade warrants attention and should be inherent to clinical practice. Less research supports recommendations with grades B and C; these should be discussed by the sports medicine staff. Grade B recommendations are based on inconsistent or limited controlled research outcomes. Grade C recommendations should be considered as expert guidance despite limited research support.

The recommendations have been delineated into 5 primary areas: legal considerations, technique and skill considerations, general patient management considerations, joint-specific recommendations, and special population considerations.

Legal Considerations

1. All ATs and their supervising physicians should consult pertinent state statutes and associated rules and regulations before developing an injury-management protocol that includes attempts by an AT to perform onsite reduction of dislocated joints.[35] *SOR: C*
2. All ATs are urged to review pertinent employer-related documents (eg, contracts, job descriptions, employment expectations, procedure manuals, policy statements) before implementing any onsite reduction protocol for a joint dislocation to ensure the protocol complies with the dictates of the institution.[36,37] *SOR: C*
3. In cases where pertinent statutes, rules and regulations, and employer policies do not restrict ATs from attempting to reduce dislocated joints, written standing orders should be provided by the supervising physician specifically indicating the circumstances under which the AT should attempt to reduce a dislocated joint, which joint dislocations the AT may attempt to reduce, and the reduction technique(s) to be used.[38] *SOR: C*

Technique and Skill Considerations

4. Patient consent, or parental consent and patient assent in the case of minors, should be obtained before any attempted reduction of a dislocated joint. All ATs should secure this written consent and minor assent before the school year or sport season.[36,37] *SOR: C*
5. All ATs should collaborate and consult with their supervising physicians to agree on specific criteria to be used in determining joints for which an onsite reduction will be attempted. *SOR: C*
6. Physicians should educate ATs on the details of the selected reduction techniques and determine, based on the skill and experience of the AT, when he or she can attempt specific onsite reduction techniques. *SOR: C*
7. Physicians should limit their delegation of reduction of dislocated joints to those ATs with verifiable education, training, experience, and competency in such procedures.[38–40] *SOR: C*
8. If a physician is onsite with the AT, the reduction technique should be determined in consultation with the physician. *SOR: C*

General Patient Management Considerations

9. A history should be obtained from the patient to identify any previous joint injuries (eg, dislocations, subluxations, surgeries), details of the current injury (eg, paresthesia or numbness, neck pain, loss of consciousness), and any medical condition that might affect injury management.[2] *SOR: C*
10. A comprehensive musculoskeletal assessment, including a neurovascular examination, must be completed before the decision is made to reduce a dislocated joint. The results of the prereduction evaluation should be documented.[6,7,20,22,41] *SOR: C*
11. Reduction of a joint dislocation should not be undertaken if the patient presents with any signs or symptoms consistent with a fracture of 1 or more bones of the involved articulation.[7,22,23,26,28] *SOR: C*
12. A neurovascular examination, including sensory, motor, and vascular status, should be repeated after each reduction attempt. Results of the postreduction evaluation should be documented.[20,23,26,28] *SOR: C*

13. All joints that are reduced onsite should be immobilized. The patient should be treated for pain and spasm and referred for further treatment, including radiographs to assure proper bony alignment and identify any associated fractures.[2,22,23,26,42–44] *SOR: C*
14. If the patient is young enough that the epiphyseal plates may still be open (as late as 22 years of age depending on sex, genetics, and numerous environmental factors), onsite reduction of a joint dislocation should not be attempted because a fracture is highly likely.[45–48] *SOR: C*

Joint-Specific Recommendations

Glenohumeral Joint.

15. Under the direction of a physician, an AT can perform an onsite reduction of a first-time or recurrent anterior shoulder dislocation as long as the diagnosis is readily apparent. However, if a fracture or a posterior dislocation is suspected, immobilization in a position of comfort and referral for radiographic evaluation should replace onsite reduction. If reduction of an anterior dislocation is not possible, the shoulder should be immobilized in a position of comfort and the patient referred for appropriate treatment. Multiple attempts at reduction are not recommended.[2,21,23,49] *SOR: C*

Femoroacetabular Joint.

16. Under the direction of a physician, an AT can attempt to reduce a hip dislocation. Ideally, the team physician would reduce this dislocation with the AT, although this is not absolutely necessary. Because many hip dislocations have associated fractures, referral for radiographic evaluation is always recommended. Concomitant neurovascular injury is common, so careful attention should be paid to the neurovascular status of the extremity before and after any reduction attempts.[7,42] *SOR: C*

Tibiofemoral Joint.

17. Under the direction of a physician, an AT can perform an onsite tibiofemoral joint reduction. Because the incidence of vascular and neural damage is high with this injury, it is important for the AT to determine the presence or absence of peripheral pulses and neurologic function before and after any reduction attempt. A patient with multiple ligament injuries should be managed as if he or she had a knee dislocation that spontaneously reduced. Immediate referral for radiographic evaluation and monitoring of the vascular supply to the extremity is highly recommended.[26,28,29,50–53] *SOR: C*

Patellofemoral Joint.

18. Under the direction of a physician and as long as the diagnosis is readily apparent, an AT can reduce an acute patellar dislocation. Multiple attempts at reduction are not recommended.[26,28,54] *SOR: C*

Humeroulnar Joint and Proximal Radioulnar Joint.

19. Onsite reductions should not be attempted in most cases given that elbow dislocations typically involve fracture(s) and significant potential for neurovascular compromise. If emergency transport will be delayed, an AT, under the direction of a physician, may attempt a reduction provided no signs and symptoms of fracture or neurovascular damage are present. Multiple attempts at reduction are not recommended.[3,6,20,41] *SOR: C*

Metacarpophalangeal Joints.

20. Under the direction of a physician, an AT can reduce a dislocated metacarpophalangeal (MCP) joint but should use caution as these dislocations often have associated fractures or interposed soft tissue (ie, tendons), which can prevent complete reduction. Some MCP injuries involve complex entrapment of the phalanx in the soft tissue, in which case closed reduction may not be possible. Multiple attempts at reduction are not recommended. [2,8,55–57] *SOR: C*

Interphalangeal Joints of the Fingers.

21. Under the direction of a physician, an AT can reduce dislocations of the interphalangeal joints of the fingers. When associated fractures or interposed soft tissue may be present, reduction attempts should be deferred until radiographs confirm the exact diagnosis. Multiple attempts at reduction are not recommended.[8,22,56,58] *SOR: C*

Metatarsophalangeal Joints.

22. Under the direction of a physician, an AT should use caution when attempting to reduce metatarsophalangeal-joint (MTP) dislocations because associated fractures or interposed soft tissue frequently prevent reduction. Multiple attempts at reduction are not recommended.[59–61] *SOR: C*

Interphalangeal Joints of the Toes.

23. Under the direction of a physician, an AT can reduce a dislocated interphalangeal joint of the toes. Multiple attempts at reduction are not recommended.[62,63] *SOR: C*

Special Population Considerations.

24. Because of the greater underlying risk of fracture in senior athletes, onsite reduction of dislocations should only be attempted for the simplest of dislocations (eg, proximal interphalangeal [PIP] dislocations of the fingers). *SOR: C*
25. Under the direction of a physician, ATs can reduce patellar dislocations in children. However, other joint dislocations in children should be reduced only after radiographs are obtained due to the presence of open physes and the greater likelihood of bony injury.[15,17,64] *SOR: C*
26. Onsite reduction of acute dislocations in athletes with diabetes mellitus is not recommended.[15] *SOR: C*
27. Onsite reduction of joint dislocations resulting from generalized tonic-clonic seizures is not recommended.[14,65] *SOR: C*

BACKGROUND AND LITERATURE REVIEW

Advantages of Onsite Reduction

When managing a joint dislocation, the main treatment priorities are to protect the neurovascular structures and to atraumatically reduce the dislocation.[33] Early onsite reduction of joint dislocations has many advantages. The most frequently cited advantage is the avoidance of muscle

spasm and swelling, which can severely limit delayed attempts at reduction.[2,5,6,23,33] Similarly, an early reduction reduces the pain and discomfort experienced by patients requiring transport and treatment at medical facilities. Other potential benefits of early reduction can include restoration of vascular flow to the limb,[33,66–68] less articular cartilage injury,[33,49] and decreased skin compromise.[2,5] Early reduction may obviate immediate patient transfer to a medical center for evaluation and treatment. However, in all cases of joint dislocations that involve onsite reduction, further evaluation with appropriate visualization studies is required but may not be emergent.

As health care professionals responsible for the immediate management of traumatic injuries, ATs are qualified to effectively manage many musculoskeletal injuries, including joint dislocations. Even though some joint dislocations may occur rarely and onsite reduction of certain joint dislocations may not be warranted in all situations, onsite joint-dislocation–management protocols should be established for all joints. Such management plans should be developed with physician consultation and should address the circumstances under which joint reduction will be attempted onsite, who is qualified to attempt the reduction, and which reduction techniques may be used.

Disadvantages of Onsite Reduction

Despite the advantages to performing onsite reduction of a dislocated joint, potential disadvantages also exist. Most concerning, an onsite reduction may be performed on a joint with an undetected associated fracture.[2] Moreover, the deformity for which the joint reduction is attempted may reflect a concomitant fracture and not an isolated joint dislocation.[2] Although rare, it is possible that this could result in further bony, soft tissue, or neurovascular injury. In addition, onsite reductions are typically performed without sedation or medication, and any reduction attempt may increase the patient's pain and discomfort.

Legal Considerations

The legal concerns associated with ATs attempting onsite reductions of joint dislocations are simultaneously complex and simple. The legal complexity results from currently having 1 state (California) without any form of athletic training regulations and 49 states and the District of Columbia with various regulations (licensure, certification, and registration), each with its own laws and associated rules and regulations.[35] Specific language, definitions, scope of practice, and practice requirements for athletic training vary among the states and the District of Columbia.[35] Additionally, the many regulatory acts regarding the practice of medicine and allied health professions that may affect ATs vary. Furthermore, state regulations always take precedence over national certification standards.[35] All ATs must keep in mind their mandatory compliance with state regulatory requirements.[35] The simplicity associated with ATs attempting onsite reductions of joint dislocations stems from the Board of Certification examination being recognized by all athletic training state regulatory agencies as meeting their examination requirement[35] and also from the fact that ATs are required to render services or treatment under the direction of a physician.[38] Therefore, before implementing a protocol for onsite reduction of dislocated joints, an AT, his or her supervising physician(s), and the appropriate administrator(s) must carefully review state statutes, rules, and regulations to establish the legality of the proposed protocol.

Most institutions employing ATs or using services provided by ATs possess documents that clearly delineate the responsibilities, duties, and expectations of the ATs. These documents often include job descriptions, employee expectations, policy and procedure manuals, and contracts. Any treatment protocol developed between a physician and an AT must comply with the dictates of the institution for which the AT provides services. As such, a protocol for onsite management of joint dislocations should be included in all appropriate employer documents before implementation.[36]

Legally, patient consent is required before any medical treatment can be administered.[36,37] Although consent is often assumed in the athletic setting, written consent specifically regarding the reduction of joint dislocations should be obtained from the patient, or in the case of a minor, from the patient and his or her parents or legal guardian, before sport participation. If written consent to reduce a joint dislocation is not obtained before sport participation, consent should be obtained before any reduction attempt. Because it is often impractical to obtain onsite written consent from a patient with a dislocated joint, witnessed oral consent may be a viable alternative with documentation to follow.

The Board of Certification "Standards of Professional Practice"[38] require ATs to render "service or treatment under the direction of a physician," which applies to the management of joint dislocations. Although the language varies slightly, states regulating athletic training also require ATs to practice under the direction or supervision of a physician. For example, the Commonwealth of Pennsylvania requires written standing orders signed by the AT and the physician as part of physician direction. A signed written protocol for onsite reduction of dislocated joints that specifically lists the joints the AT can reduce and the circumstances under which the reduction may be attempted may offer protection from potential misunderstandings between physicians and ATs, especially when written standing orders are not required by law.

Like other allied health care professionals, ATs should not render any service or treatment for which they are not properly trained, educated, and authorized. Historically, onsite reduction of dislocated joints has not been included in the "Athletic Training Education Competencies,"[39] and thus, it is not considered an entry-level knowledge, skill, or clinical ability. However, new Commission on Accreditation of Athletic Training Education "Standards for Accreditation of Professional Athletic Training Programs" were adopted on January 9, 2018, and go into effect on July 1, 2020.[40] Standard 70 (under "Examination, Diagnosis, and Intervention") states that the education of athletic training students must include the evaluation and management of patients with acute conditions, including triaging conditions that are life threatening or otherwise emergent.[40] A list of conditions including but not limited to fractures and dislocations, along with reduction of dislocations, appears within the standard.[40] With these modifications of program standards, the education of ATs regarding

reduction of joint dislocation is beginning to change, and clinical application of this item is expected to become more prevalent in the near future. As new and already credentialed ATs become more routinely educated in this clinical skill, we anticipate that actual practice will change accordingly. Still, ATs will vary in the knowledge, skills, and experience required for the management of joint dislocations. Therefore, physicians supervising or directing ATs should verify the knowledge and skills of the ATs to whom they delegate responsibility for onsite reductions of joint dislocations.

Considerations of Individual Joints

Glenohumeral Joint. The glenohumeral joint is the most commonly dislocated major joint, especially in athletes participating in contact sports,[23] with the most frequent complication being a high recurrence rate.[2] Anterior glenohumeral dislocations occur often,[69] can cause the patient a tremendous amount of pain, and are much more difficult to reduce once swelling and muscle spasm have developed.[2] In the absence of any obvious signs of fracture or significant neurovascular compromise, radiographs may not be necessary, and an onsite attempt to reduce an anteriorly dislocated glenohumeral joint is indicated.[23] However, delayed reduction rarely results in significant harm, so if there is any question or concern about the diagnosis or the possibility of fracture, reduction of the glenohumeral joint can be safely deferred most of the time until radiographs are obtained. Yet if the attempt at early reduction is delayed, muscle spasm and guarding may make subsequent reduction attempts more difficult to accomplish.[23,70] Anterior glenohumeral-joint dislocations are easily reduced, although infrequently, soft tissue or osseous interposition may impede or prevent satisfactory reduction.[9–11] Additionally, fractures of the humerus or glenoid can occur before or during an attempt to reduce an anteriorly dislocated glenohumeral joint. Even though iatrogenic fracture is uncommon, reduction of the glenohumeral joint should not be forceful.

Posterior dislocation of the glenohumeral joint is rare, accounting for only 1% to 2% of all shoulder dislocations.[71] The most common causes of posterior dislocation are epileptic seizures, electrical shock, and falls on the outstretched hands.[72] Cuffolo et al[73] reported on a posterior dislocation that occurred secondary to losing control of weights while performing the extension portion of the bench-press exercise in the supine position. Posterior dislocations may be associated with surgical neck fractures, fractures of the tuberosities (about 10% of the time), or a ventral impression fracture of the humeral head known as a *reverse Hill-Sachs lesion*.[71,72]

Glenohumeral-joint reduction is aimed at achieving an atraumatic reduction as soon as possible, thereby providing the athlete with pain relief.[49] Once the glenohumeral joint has been successfully reduced, a postreduction neurovascular examination should be performed, paying particular attention to the axillary and musculocutaneous nerves.[23] Additionally, the patient should be splinted and referred to the appropriate health care facility for radiographs to assure satisfactory joint alignment and rule out associated fractures.[23]

Femoroacetabular Joint. Unlike glenohumeral-joint dislocations, dislocations of the hip joint rarely occur in the athletic setting.[41,74–76] However, hip dislocations with accompanying bone and soft tissue trauma have been reported in many different sports, including basketball, football, gymnastics, jogging, rugby, and skiing.[7,12,30,76–83]

Immediate management of a hip dislocation necessitates a thorough physical examination, including a neurovascular assessment with special attention to the sciatic nerve and the peroneal branch.[7] Due to its proximity to the femoral head, the sciatic nerve can be injured with a posterior hip dislocation.[13,30,31] However, sciatic nerve injury is more common after a fracture-dislocation than after an isolated or simple dislocation.[41] If a thorough examination determines the patient is stable and conscious and has no obvious precluding injuries (such as a fracture), a single attempt at closed reduction can be made onsite by qualified personnel.[7] Nevertheless, it is important to keep in mind that a mechanical block (ie, "buttonholing" through the capsule) or interposition of the hip joint's anatomical structures (ie, capsule, labrum, ligamentum teres; bone fragments; or rectus femoris, iliopsoas, piriformis, or gluteus maximus muscles) may result in a sport-induced hip dislocation that cannot be reduced by closed methods.[12,13]

After a hip dislocation has been successfully reduced onsite and the patient's neurovascular status assessed and documented, he or she should be transported to an appropriate health care facility to determine the presence of a possible intra-articular hip-joint injury.[41,83] In reporting on arthroscopy among 14 professional athletes whose traumatic hip dislocations were reduced, Philippon et al[83] noted that all athletes had a labral tear and chondral defects. Additionally, patients presented with intra-articular loose fragments and disruption of the ligamentum teres.[83] These findings suggest that, even in the absence of an articulating bone fracture, a traumatic hip-joint dislocation may be accompanied by intra-articular joint injury.

It has been suggested that prompt reduction of a dislocated hip is important because delaying relocation could contribute to the development of avascular necrosis (AVN) of the femoral head.[1,68] By reducing the dislocation in a timely fashion, blood flow to the femoral head may be reestablished as tension across the femoral and circumflex blood vessels is lessened.[68] However, experts are not in agreement as to the hours of delay required to cause AVN or even if a delay in reduction actually causes AVN.[1,7] Research[4] suggested that reduction of a hip dislocation should be accomplished within 6 hours to avoid AVN, yet other investigators[1,7] believed AVN might be more related to the direction of the dislocation and the severity of the initial trauma in conjunction with the extent of any associated injuries.

Tibiofemoral Joint. Due to gross deformity, unreduced knee dislocations are readily apparent upon observation and physical examination.[26] However, many knee dislocations spontaneously reduce and present only as multiple-ligament injuries.[26,28,52] Therefore, all multiple-ligament knee injuries should be evaluated and treated as dislocations until proven otherwise.[53,84]

The neurovascular status of a potentially dislocated tibiofemoral joint should be carefully determined. Vascular injury occurs with knee-joint dislocation in 10% to 64% of

patients.[26,50] The popliteal artery is at significant risk for injury because disarticulation of the knee joint produces direct or intimal damage to the artery, resulting in occlusion.[85] In addition to the popliteal artery, an onsite examination of a potentially dislocated tibiofemoral joint should include the dorsal pedal and posterior tibial pulses. Yet the presence of a dorsal pedal pulse may not eliminate the possibility of a significant arterial lesion.[29] The onsite neurologic assessment should include motor and sensory testing of the tibial and peroneal nerves.[26,28] The peroneal nerve is more frequently injured via a dislocation mechanism than the tibial nerve because it is relatively tethered at the fibular head and has less intrinsic protection from tensile forces.[86–90]

It has been suggested[85,91] that onsite management of a suspected knee-joint dislocation consists of immediate splinting of the knee in extension, or in the most comfortable position, with immediate transport to the nearest appropriate health care facility. Conversely, proponents[2,26,50,51] of onsite reduction of a tibiofemoral joint dislocation advise attempting immediate reduction in an effort to preserve neurovascular structures that may have been subjected to prolonged compromise while the joint was disarticulated.

Whether or not onsite reduction is achieved, the neurovascular status should be continually assessed and the joint immobilized, preferably with a rigid splint to prevent further displacement and potential injury to the neurovascular structures. The patient should be treated for pain and emergency medical services activated for expeditious transport to a hospital.[2,26] Because of their significant association with neurovascular injuries,[26,50,87] tibiofemoral-joint dislocations are considered orthopaedic emergencies[26] and potentially limb threatening.[91] As such, a poorly managed or misdiagnosed tibiofemoral-joint dislocation can have limb-threatening consequences.[51]

Patellofemoral Joint. Patellofemoral-joint dislocations occur commonly in the athletic setting and may be categorized as an acute primary (first-time) traumatic patellar dislocation or a recurring chronic injury. Almost all patellar dislocations occur laterally, resulting in trauma to the medial patellar stabilizers. Superior patellar dislocations without patellar tendon disruption have been reported,[92–94] but these rare cases typically occurred in nonathletic, aged patients.

Frequently, patients classified as chronic dislocators will spontaneously reduce a lateral patellar dislocation with little to no intervention, but patients sustaining a first-time patellar dislocation and some habitual dislocators may not spontaneously reduce the dislocation. When the patella does not reduce spontaneously, some authors[2,26] indicated the patella should be reduced manually. It is important to keep in mind that athletes who have sustained a patellofemoral dislocation should be suspected of having an accompanying osteochondral fracture.[54] Interestingly, the patellar fracture may occur from the initial dislocation or from the subsequent spontaneous or manual reduction. The chondral injury may occur as the patella dislocates,[95,96] or the reduction itself may create the osteochondral lesion as the patella relocates by riding over the lateral femoral condyle.[97] Therefore, any manual reduction of a patellar dislocation should be accomplished as atraumatically as possible.

Humeroulnar Joint and Proximal Radioulnar Joint. Except for the glenohumeral joint, the humeroulnar joint is the most frequently dislocated large joint in the human body.[20,98] Elbow dislocations are classified as either simple or complex, depending on the absence or presence, respectively, of a fracture of the articulating bones.[41] Yet simple dislocations can also be accompanied by small bone fragments originating from the epicondyles or the coronoid process that do not affect joint stability.[41] Simple dislocations are described based on the location of the radius and ulna relative to the humerus (ie, posterior, anterior, lateral, medial, or divergent) with the majority of elbow-joint dislocations being posterior or posterolateral.[3,41] An anterior elbow dislocation, although a less commonly occurring simple dislocation, always involves a fracture of the olecranon.[99,100] *Divergent dislocations*, in which the ulna dislocates medially and the radius dislocates laterally, are very rare but present with the least stable patterns due to the extensive soft tissue disruption.[101] A traumatic dislocation of the proximal radioulnar joint typically results in significant joint pain and dysfunction, even though gross deformity may be absent upon examination.[101] Most complex elbow dislocations involve a fracture of the coronoid process and significant disruption of the ulnar collateral ligament or radial collateral ligament (or both)[3] but are usually stable after closed reduction.[20]

An elbow dislocation typically presents with marked deformity, swelling, and severe pain.[20] The patient may hold the involved elbow with the contralateral hand and be unwilling or unable to move the elbow through any range of motion. Prereduction management includes a thorough musculoskeletal examination to identify the type of deformity, any open injury,[20,41] and crepitus, which may indicate a fracture.[6] The presence of a fracture negates consideration of onsite reduction. It should also increase the AT's suspicion of a brachial artery injury, which most often occurs in the presence of a fracture associated with an open[20] or closed dislocation.[27,102–105]

A neurovascular examination should also be conducted and the results documented before and after any joint-reduction attempts.[20] A diminished radial or ulnar pulse or prolonged capillary refill indicates a possible brachial artery injury.[27] During the neurovascular examination, the median and ulnar nerves should also be assessed, as these structures may become entrapped within the joint as a result of the incongruency or the subsequent reduction.[27] Although rare, complex elbow dislocations can result in brachial artery injury or ulnar nerve neurapraxia (or both).[6,20] However, most neurovascular compromise is relieved with reduction.[6]

The literature[27,106–108] clearly suggests that early closed reduction of uncomplicated elbow dislocations produces positive outcomes. Yet elbow dislocations can be very painful, making onsite reduction difficult. Some authors believe that onsite reduction of an elbow dislocation should not be attempted[3,6,20] or should only be attempted when the examination reveals neurovascular compromise or if transport to the appropriate health care facility cannot take place quickly.[3,6]

Metacarpophalangeal Joints. Dislocations of the joints of the thumb and fingers occur often in the athletic setting, especially to players in sports that involve routine contact of the hands with another player, an object such as a ball, or a fixed surface.[2,8,109] The first MCP joint of the thumb is the

most commonly dislocated MCP joint,[55] typically dislocating secondary to a forceful hyperextension mechanism.[56] The lesser MCP joints of the hand, although less frequently dislocated, can dislocate in either a dorsal or volar direction.[2]

Management of simple dorsal first MCP dislocations should include an attempt at onsite reduction.[2] Because reduction techniques for this dislocation may be subtly different than those for PIP and dorsal interphalangeal (DIP) dislocations, ATs should consult with their supervising physicians for education on these techniques.[2] Similarly, onsite reduction of simple lesser (second through fifth) MCP dislocations, in which the proximal phalanx lies dorsal to the metacarpal head, paralleling the shaft of the metacarpal and involving no soft tissue obstruction, is a relatively easy procedure.[54–56] However, in complex dislocations, the reduction attempt often fails due to the buttonholing effect of the soft tissue.[8] These more complex injuries typically require surgical reduction under anesthesia.[8]

Interphalangeal Joints of the Fingers. Due to its inherent stability, the interphalangeal (IP) joint of the thumb rarely dislocates.[110] Most dislocations of the thumb IP joint are reducible, and only a few cases of irreducible dislocations have been reported in the literature.[110] The inability to reduce a dislocation of the IP joint of the thumb has been attributed to interposition of the flexor pollicis longus tendon between the ulnar condyle of the proximal phalanx and the base of the distal phalanx,[111] imposition of a free-floating sesamoid bone,[112] rupture of the palmar plate,[111,113] or a combination of 2 or more of these anatomic elements.[110,114,115]

The IP joints of the lesser (second through fifth) digits of the hand are among the more commonly dislocated joints in athletes.[22,58,116] The most frequent finger IP dislocations occur dorsal to the PIP joints.[22,58,116] A *dorsal dislocation* indicates the distal segment has dislocated dorsally in relation to the proximal segment. Conversely, a *volar dislocation* of the PIP is characterized by displacement of the middle phalanx anterior to the head of the proximal phalanx.

A dorsal PIP dislocation can be a straight dorsal dislocation or accompanied by radial or ulnar deviation.[8,22] However, for a dorsal PIP dislocation to occur, the volar plate and a portion of 1 or both collateral ligaments must be ruptured.[58,117] Volar and lateral PIP dislocations occur less often than dorsal PIP dislocations and may present with various angles of deformity.[8,56,57,117]

Reduction of a lesser digit dorsal PIP joint dislocation can often be performed very quickly with simple traction and appropriately applied pressure.[8,22,56,58] Closed reduction of an uncomplicated IP joint dislocation should be attempted as early as possible because swelling may continue for 24 to 48 hours postinjury; the accumulated hemorrhage and edema in the soft tissue decreases tissue elasticity, which may contribute to a more difficult reduction.[5] A musculoskeletal examination to assure the deformity is due to a simple IP joint dislocation and not due to an associated fracture should precede an onsite reduction attempt. Any signs of fracture preclude an attempt at reduction.[22] Abnormal neurovascular examination findings may prompt, rather than preclude, immediate joint reduction.[22] After a successful reduction, the PIP joint should be splinted and the patient evaluated by a physician, who may obtain radiographs to evaluate joint congruity.[22,43,44] The decision to return a patient to activity after a successful PIP reduction should be based on the absence of other injuries, potential forces at the joint, and performance expectations.[80,118]

Rarely, a dorsally dislocated PIP joint cannot be reduced due to impingement of the proximal phalangeal head between the central slip and the lateral bands.[57,58,117] Similarly, a volar dislocation tends to rupture the extensor mechanism, which may include the central slip, causing the proximal phalanx to become interposed between the central slip and the lateral band.[24,25] In both situations, onsite closed reduction may not be possible.[117] If the onsite reduction cannot be performed, the reduction should be deferred until either radiographs are obtained or a digital nerve block can be administered. Postreduction, most dorsal PIP joint dislocations are stable because the collateral ligaments remain attached to the middle phalanx.[57,109] However, volar dislocations are generally unstable after reduction.[119]

Dislocation of the DIP joint is uncommon[120] and usually caused by a crush-type injury mechanism.[117,121] It can occur dorsally or, much less often, volarly.[57] In the absence of a fracture or other contraindication to reduction, a DIP joint dislocation can be reduced and treated similarly to a PIP joint dislocation.[56]

Metatarsophalangeal Joints. Traumatic dislocation of the first (hallux) MTP is infrequent[60,61] but may occur in sport activities. The first MTP's shallow, glenoidlike cavity contributes little to the joint's stability, most of which comes from the capsular-ligamentous-sesamoid complex.[114] The first MTP joint can dislocate in any direction; the dorsal direction is most common,[61,122] but plantar and lateral dislocations have been described.[122]

Irreducible first MTP joint dislocations have been attributed to the type of dislocation, involvement of the sesamoid complex, and interposition or locking of the abductor hallucis or flexor hallicus longus tendons.[123–126] However, not all hallux MTP joint dislocations are resistant to closed management [61,122] Additionally, the location for successful reduction of a hallux MTP dislocation differed in the literature.[61,122] In a 2000 publication, Watson et al[122] recommended attempting reduction of all closed dislocations, regardless of type, in the emergency department after a physical examination is conducted, appropriate radiographs are obtained, and adequate anesthesia is administered. More recently, a case report[61] documented a successful onsite closed reduction of a football player's dorsal first MTP joint dislocation by an AT. The authors noted that their success may have been due to the short time between injury and treatment, which began with successful reduction.[61] Regardless of the venue, all patients should be advised of the possible need for acute operative intervention should attempts at closed reduction fail.[122]

Lesser toe (second through fifth) MTP joint dislocations are rare, with the fifth MTP joint dislocating more frequently than the 3 lesser toes.[59,63,127] Dislocation in the dorsal direction is most common.[59,127–129] In a retrospective analysis[59] of lesser toe MTP joint dislocations, 24 of 27 displaced dorsally, 3 displaced dorsolaterally, and closed reduction was successful in 16 of the 27 patients. As reported by others,[127–129] the plantar capsule and plate

presented the most typical impediments to closed reduction.[59] Despite the high percentage (almost 30%) of lesser toe MTP joint dislocations unsuccessfully managed with closed reduction, Brunet and Tubin[59] suggested the initial treatment for acute lesser toe MTP joint dislocations include an onsite attempt at closed reduction.

Interphalangeal Joints of the Toes. Dislocation of the first or lesser toe IP joints is infrequent and rarely reported in the literature.[130,131] However, because these injuries are often self-reduced or reduced by medical or allied health personnel without subsequent medical referral, they may actually occur more often than reported. Similar to the fingers, most toe IP joint dislocations are simple in nature, and an onsite reduction should be attempted,[62,63] yet some IP joint dislocations may be irreducible and require open reduction.[59,63,132,133]

Special Population Considerations

These recommendations regarding appropriate management of joint dislocations may be altered if the injury affects an athlete who, because of underlying abnormalities in either anatomy or physiology, requires additional considerations as to who manages the dislocation and when and where this occurs. Such anatomic and physiological abnormalities may be present because of the athlete's age or underlying medical condition. For the purposes of this document, we will discuss potential special considerations given to senior athletes, child and adolescent athletes, and athletes who have diabetes mellitus or seizure disorders. However, it is important to bear in mind that no strong outcomes data have addressed who should reduce a dislocation in these patients or where the reduction should be performed. The recommendations put forth in this document are merely extrapolations based on the known underlying anatomy and physiology of these groups.

Senior Patients. In treating seniors with joint dislocations, 2 competing realities exist. First, seniors are more likely than younger adults to have inadequate bone mineral density. This relative osteopenia compared with younger populations places them at greater risk of concomitant fracture in the event of a joint dislocation. Second, whereas the most likely complication of many dislocations in younger populations is recurrent instability,[16,19] the most likely risk in older populations is additional soft tissue injury (eg, torn rotator cuff) and residual joint stiffness. Osteopenia and the associated risk of concomitant fracture necessitate extra caution when performing an onsite reduction without prior radiographs. Therefore, all but the simplest dislocations in seniors (ie, PIP dislocations of the finger) should be reduced by a physician after radiographs have been obtained.

Pediatric Patients. The management of dislocations in pediatric patients, including children (aged 6–12 years) and adolescents (aged 13–18 years)[134] is complicated by the presence of open growth plates.[45–48] The open physes of the pediatric athlete present an area of relative weakness against the stress applied to the bone and adjacent tissues. Growth plate injury can result in complete or partial growth arrest.[135] Therefore, the possibility of underlying physeal injury must be taken into account.

In children, dislocations of the shoulder, elbow, hip, knee, and ankle are rare injuries. In the shoulder, children with open physes will be much more likely to sustain a Salter type 2 fracture of the proximal humerus than a glenohumeral dislocation.[64] Glenohumeral-joint dislocations become more common as children age and the physes close,[136] which occurs between 16 and 22 years of age, depending on the child's genetics and sex as well as numerous environmental factors. If a child sustains a suspected glenohumeral dislocation, it should not be reduced onsite. Instead, the young athlete should be splinted and transported for radiographic evaluation and subsequent care. When the growth plates close in adolescence, glenohumeral dislocations can be managed as in adults.

Elbow-joint dislocations in children are also rare, as fractures are much more frequent.[17] A suspected elbow dislocation should not be reduced onsite. Radial head subluxation, or "nursemaid elbow," is a common injury in children up to about age 5.[15] The subluxation is usually easily reduced, but because of the age group in which it occurs, ATs will not often encounter it professionally.

Knee and ankle dislocations, as noted earlier, are rare injuries that should not be reduced by ATs onsite. However, patellofemoral-joint dislocations can occur more frequently in children. Although many of these reduce spontaneously, those that do not can be reduced in the same fashion as for an adult.

Diabetes Mellitus. Like seniors, patients with type 1 or 2 diabetes mellitus face an increased risk of postinjury joint-capsule stiffness and adhesive capsulitis.[15] Young adults with well-controlled diabetes may not face the same increased risk of concomitant fracture that is present in senior and pediatric patients.[137] Currently, evidence is lacking to suggest that young patients with diabetes experience the same benefits from onsite joint dislocation reduction as those without diabetes. Therefore, onsite reduction of a joint dislocation by an AT is not recommended.

An additional concern in diabetic patients is joint instability. Individuals with neuropathic changes in the feet can be predisposed to progressive ligamentous instability in the foot and dislocations, most commonly in the midfoot region.[18] Neuropathic foot conditions, or Charcot joints, are more frequent in patients with long-standing peripheral neuropathy. The degree of debilitation inherent in such an individual makes it extremely unlikely that this condition would be encountered in an athletic setting. Furthermore, these dislocations are not acute dislocations but chronic, progressive problems.[138] Reduction of these dislocations by an AT is not recommended.

Seizure Disorder. The violent muscular contractions that occur in an individual who sustains a generalized tonic-clonic seizure are strong enough to induce joint dislocations. The classic joint dislocation associated with seizure activity is the posterior shoulder dislocation. In the normal setting, posterior shoulder dislocations are dramatically less common than anterior dislocations, accounting for less than 5% of all shoulder dislocations.[139] However, with generalized seizure activity, the imbalanced, violent contractions of the muscles of the posterior shoulder girdle can result in a posterior dislocation, often with a concomitant humeral head fracture.[65] This can also occur bilaterally, resulting in what is referred to as *triple E syndrome*: bilateral locked posterior shoulder fracture-dislocations typically seen only

with epilepsy, electrocution, and extreme trauma.[14] Needless to say, it is inadvisable to attempt onsite reduction of such injuries. However, it is important to be aware of their possible presence. An individual in the postictal state may not be able to complain of shoulder pain from these injuries. Identifying these dislocations early can lead to more prompt treatment at the health care facility and decrease the likelihood that they go unrecognized.

CONCLUSIONS

When establishing recommendations on the immediate management of joint dislocations, the following factors must be taken into consideration: legal aspects, technique and skill, patient management, joint-specific recommendations, and the patient population. On reviewing these recommendations, it is ultimately the responsibility of every AT and his or her institution to develop a plan for managing joint dislocations that is unique and relevant to the setting. It is vitally important that this written plan be researched, discussed, and agreed upon by all pertinent health care providers at each site. A joint-dislocation–management plan, developed with physician consultation, should comply with state athletic training practice regulations. Additionally, it should specify the joints for which onsite reduction may be considered, the circumstances under which joint reduction may be attempted, the persons qualified to attempt the reduction, and the reduction techniques to be used. This plan may need to be modified for specific populations, such as children and those with special health concerns.

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