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INTRODUCTION

The fifth edition of the Athletic Training Education Competencies expanded the scope of knowledge and skill set of entry-level athletic trainers in the domain of Acute Care of Injuries and Illnesses.¹ For example, the educational competencies now include the introduction of adjunct airway techniques² and the use of pulse oximetry to assess oxygen saturation levels.³ Two other competencies (Table 1), although not necessarily new to the list of immediate emergency management care skills, do require further examination based on the current available science and standard of care in prehospital medicine. The purpose of this column is to provide athletic training educators (ATE) with evidence regarding the use of tourniquets in the prehospital setting as well as to be a resource on how to teach the management of external hemorrhage using tourniquets.

Trauma resulting in disruption of soft tissue is classified as an open or closed wound, and any significant loss of intravascular volume may lead sequentially to hemodynamic instability, decreased tissue perfusion, cellular hypoxia, organ damage, and death.⁴ In a closed wound, the outer layer of skin remains intact, with damage to the underlying tissue presenting as an ecchymosis and possibly a hematoma. An open wound or a disruption in the continuity of the integumentary system results in external hemorrhaging that must be controlled to prevent worsening of the condition and to limit any risk of increased mobility or mortality. Open wounds include (1) abrasions, (2) avulsions, (3) blisters, (4) incisions, (5) lacerations, and (6) punctures and penetrations. For more information on the clinical presentation of open wounds, please refer to a first aid or emergency response/trauma textbook such as Emergency Response Management for Athletic Trainers.⁶

Estimating Blood-Volume Loss

The extent of external hemorrhaging depends on the location and severity of the trauma. For example, trauma causing arterial damage is normally more lethal than trauma causing venous lesions owing to the higher arterial pressure, which causes more rapid and significant losses of blood volume.⁷ Estimating blood loss, though, is complicated by several factors including urinary losses, development of tissue edema, age of the patient, and the patient’s comorbidities and current physiological state (eg, pregnancy).⁴ For example, an average adult’s blood volume represents about 7% of the total body weight (BW) (ie, 70 mL/kg of BW). Thus, estimated blood volume (EBV) for a 70-kg (154-pound) person is approximately 5 L (169 ounces).⁴ However, blood volume varies with age and current physiologic state, as previously mentioned. When indexed to BW, older adults will have a smaller blood volume compared with younger adults. Children will have an EBV of 8% to 9% (80 to 90 mL/kg) of BW, with infants having an EBV as high as 9% to 10% (90 to 100 mL/kg) of their total BW.

When arriving on the scene at an emergency situation, the severity of the blood-volume loss (and subsequent replacement) can be estimated based on the patient’s clinical presentation as well as the general impression of the amount of fluid loss and age at the emergency. This estimated blood loss is divided into four classes (Table 2), based on the amount lost.⁵ Class I hemorrhaging is commonly described as a “nonshock state”⁴ and can be seen when a person donates a unit of blood (which, for perspective, normally requires 10% of a person’s blood volume⁵). On the opposite end of the continuum is Class IV hemorrhaging. This is considered a “preterminal event,” and the magnitude of exsanguination is immediately life threatening.⁵ Therefore, an athletic trainer should immediately examine the patient’s clothes and surrounding areas for blood loss.⁵ When bleeding is uncon-
Based on a 70-kg adult.

Table 2. Classification of Hemorrhage Based on Estimated Blood Loss

<table>
<thead>
<tr>
<th>Blood loss, mL&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood volume loss, %</td>
<td>750</td>
<td>750–1500</td>
<td>1500–2000</td>
<td>&gt;2000</td>
</tr>
</tbody>
</table>

<sup>a</sup> Based on a 70-kg adult.

Shock

When the body is unable to provide adequate tissue perfusion capable of sustaining aerobic metabolism, the clinical state of hypoperfusion, or shock, develops. Shock can be produced by decreases in cardiac output (cardiogenic shock), decreases in respirations (respiratory shock), increases in cardiovascular system size (ie, blood vessels vasodilation seen in anaphylaxis), sepsis (distributive shock), or decreases in intravascular volume (hypovolemic shock). The latter may be caused by dehydration from vomiting or diarrhea, by severe environmental fluid losses (exertional heat illness), or by rapid and substantial loss of blood, which is also known as hemorrhagic shock.

The clinical presentation of hemorrhagic shock is a progressive condition and dependent on the status of hypoperfusion’s clinical presentation, which will change over time. Decreases in circulating blood volume during hemorrhaging can suppress cardiac output and lower organ perfusion pressure, resulting in hypoxia. When vital organs, such as the brain, heart, and lungs, do not receive sufficient oxygenated blood, the body responds with a series of responses to protect these organs. Some tissues, though, are more resistant to hypoxia than others. For example, skeletal and smooth muscles are highly resistant to hypoxia, and irreversible damage does not occur until 2.5 hours of ischemia. This is in comparison to the gut, which appears to be particularly sensitive to decreases in tissue perfusion, and the brain cells, which sustain permanent damage after only a few minutes of hypoxia. Thus, regardless of the causes, the treatment of shock should be proactive versus reactive.

To compensate for the loss of blood, the body reacts defensively through a catecholamine release by the sympathetic nervous system and produces a series of reactive events or stages of shock (Table 3). Vasoconstriction causes blood flow to be shunted from the extremities to the major organs. This vascular constriction serves to maintain an adequate blood pressure and perfuse the organs with vital nutrients and oxygen needed to survive. As a result, there is decreased blood flow to the skin, which results in a presentation of cyanosis: the skin is pale or ashen (grayish) in color, cool to the touch, and moist (diaphoresis). The catecholamine release results in restlessness and agitation, increases heart and breathing rates, and may cause nausea. If perfusion is not restored, other physiological processes including brain function will be affected. The brain requires a constant supply of blood (ie, oxygen) to maintain normal function, and the body will strive to preserve mental function. Late signs of shock include the presentation of altered mental status and a drop in blood pressure.

Controlling Bleeding

Controlling external bleeding is a skill taught in all basic and advanced first aid courses and one of the few actions in which initial emergency care can critically influence a patient’s outcome. “Bleeding is best controlled by applying pressure until bleeding stops or EMS rescuers arrive (Class I, LOE A).” Should the bleeding or is not possible and access to medical resources is not immediately available, the immediate application of a tourniquet by a properly trained responder should be considered.

TOURNIQUETS

A tourniquet is a tight band (commercial or improvised) placed around an arm or leg to constrict blood vessels to stop blood flow to a wound. Over the past decade the use of...
Tourniquets has increased; they are commonly used by military and tactical personnel in hostile and hazardous environments. Military personnel each carry two tourniquets in case they lose more than one extremity, as has been frequently experienced in Iraq and Afghanistan. Injuries such as avulsions, amputations, and lacerations have the potential to create massive external bleeding that, if not quickly managed, will result in exsanguination and death. The attack during the Boston Marathon in April 2013 illustrates the necessity of managing extreme trauma to extremities in the civilian setting. During this horrific event, more than 170 people were injured when two explosive devices went off along mile 26 of the marathon. Physicians, including those at Beth Israel Deaconess Medical Center in Boston, believe that the use of tourniquets in the prehospital setting saved patients’ lives.

**History**

As a medical device, tourniquets have a long and rocky history. They arose from the need for battlefield surgeons to control bleeding during surgical amputations, with use dating as far back as ancient Rome. In 1517, Hans von Gersdorff published a trauma surgery atlas that described tourniquet use in amputation surgery. In the 16th century, Ambrose Pare, a barber and surgeon, recommended tying “a strong or broad fillet like that which women usually bind up their haire withal.” Wilhelm Fabry and Etienne Morel both described the use of windlass-based tourniquets, wherein a stick was used to twist a circumferentially constrictive bandage during amputation surgery and a belt threaded through a wood block (with a hole at each end) where the stick was used in the loop of the belt around the limb to twist as a windlass (creating the block tourniquet) as a battlefield tourniquet, respectively. In World Wars I and II, many limbs were needlessly constricted and had to be amputated because the improper application of tourniquets increased.

### Table 3. Stages of Shock

<table>
<thead>
<tr>
<th>Stage</th>
<th>Name</th>
<th>Clinical Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Initial</td>
<td>Mean arterial pressure decreased less than 10 mm Hg. Compensation is effective. No visible changes.</td>
</tr>
<tr>
<td>II</td>
<td>Compensated</td>
<td>Body’s primary goal is to maintain blood flow to heart and brain through vasoconstriction (release of epinephrine) and shunting blood to vital organs. Anaerobic metabolism begins to occur. The body maintains perfusion by decreased peripheral blood flow, tachycardia to maintain cardiac output, tachypnea. Distal pulses become weak skin will present as pale, cool, and diaphoretic, and blood pressure initially seems normal.</td>
</tr>
<tr>
<td>III</td>
<td>Decompensated or progressive</td>
<td>Inability of the body to sustain adequate perfusion. As hypoxia develops the patient becomes confused and disoriented; as blood pressure decreases, distal pulses become difficult to locate. Patient presents with flat neck veins, pale, cool, clammy skin, hypotension, and oliguria.</td>
</tr>
<tr>
<td>IV</td>
<td>Refractory or irreversible</td>
<td>Impending death as the body is no longer able to adjust for the extreme blood loss; tissue perfusion is negligible, allowing for cellular necrosis due to lack of adequate oxygen tension. Heart function continues to decline becoming slow and irregular; multi-system organ failure occurs.</td>
</tr>
</tbody>
</table>

*a Modified from Miller and Berry; Gutierrez et al.*

![Figure 1. Direct pressure. a, Fingertip direct pressure. b, Whole-hand direct pressure.](image)
rapidly. The original injury itself was often relatively minor and certainly would not have caused a fatal hemorrhage.

During the Spanish Civil War in the 1930s,

Douglas W. Jolly wrote that “more limbs and lives are lost at the front from the improper use of the tourniquet than are saved by its proper use.” He stressed tourniquets in use be detected by providers of emergency care because tourniquets could be covered and unseen under splints, clothing, or blankets. Jolly, an experienced field surgeon, observed that both improper and proper use of the tourniquet occurred, but he gave no supporting data and provided no further description.

During the Vietnam War, many US Army reports contained limited tourniquet data, but analyses led to an estimated rate of deaths from limb hemorrhage potentially attributable to tourniquet use at 17% among US casualties. Today, although tourniquets have been shown to control bleeding effectively on the battlefield and during surgery and have been used by paramedics in a civilian setting without complications, there are no studies on first-aid providers (laypersons) controlling bleeding with tourniquets. However, athletic trainers are not laypersons and with proper training can properly apply a tourniquet in an emergency.

Clinical Evidence

In 2013 Kragh et al. analyzed emergency tourniquet use in combat casualty care and documented the impact of process-improvement efforts over time on tourniquet success rates. Prospective data were collected and analyzed over three separate time periods in a military hospital that supported combat and related security work in Iraq, where casualties, including civilians, were admitted directly or transferred from forward surgical teams. Prehospital tourniquets were applied by people with a wide range of medical skills and included (1) casualties themselves, (2) bystanders, (3) soldiers, (4) medics, (5) nurses, and (6) doctors.

The total study population was 727 (232, 267, and 228 for periods 1, 2, and 3, respectively). In all, 1212 tourniquets (89% applied in the prehospital setting) were applied on 952 limbs. Survival rates were calculated at 88% (86.6%, 86.9%, and 90.8% for periods 1, 2, and 3, respectively, P = .035) was 97%. Of the tourniquet applications, 99% were appropriate with only 1% used distal to a proximal wound. There were reports of loose tourniquets (7%) and broken tourniquets (1%); in a majority of the cases, the use of only 1 tourniquet was necessary (76%).

Beekley et al. examined the effects of prehospital tourniquet use on the hemorrhage control and outcomes during Operation Iraqi Freedom. A retrospective analysis of the 31st Combat Support Hospital for 1 year during Operation Iraqi Freedom found that of the 3444 total admissions, 165 patients met inclusion criteria. Of these, 67 patients had a prehospital tourniquet; 98 patients had severe extremity injuries but no prehospital tourniquet. A total of 80 tourniquets were placed on the 67 patients. For those patients...
who arrived with tourniquets, 41 (61%) had prehospital tourniquet times documented. The average tourniquet application time was 70 minutes (range, 5 to 210 minutes).

An examination of hemorrhage control found that the use of a tourniquet resulted in no bleeding on arrival at the combat support hospital in 83.3% of the patients versus 60.7% (P = .033) of the patients when no tourniquet was used. Further analysis found a significant difference in bleeding control with 85% of patients with a tourniquet having no bleeding on arrival at the combat support hospital versus 40% (P = .037) of the patients when no tourniquet was used. Twelve (18%) of the patients in the tourniquet group had no documented vascular injury or major traumatic amputation, thus the tourniquets were not indicated. However, prehospital observations regarding the extent of the initial bleeding in the field were not noted at the time of application; thus they may have been warranted at the time of application. One (1.5%) tourniquet was documented as incorrectly placed (ie, placed distal to the wound). Overall, the data suggest that prehospital tourniquet use was associated with improved hemorrhage control, particularly in the subset of patients who had worse injuries (Injury Severity Score >15) with no early adverse outcomes. According to Beekley et al,13 57 of the deaths might have been prevented by earlier tourniquet use.

**CONSIDERATIONS FOR USE IN THE PREHOSPITAL SETTING**

According to the 2010 American Heart Association and American Red Cross guidelines for first aid, commercially designed tourniquets "appear to be better than ones that are improvised, but tourniquets should only be used with proper training (Class IIa, LOE B)."

### Indications, Precautions, and Contraindications

**Indications.** When the application of direct pressure to the site of a hemorrhage does not control external bleeding, the immediate placement of a tourniquet on an extremity injury is necessary and application should not be delayed. Specific indications for the use of a tourniquet can be found in Figure 2. The use of pulse pressure points and elevation of injured extremities is now discouraged due to the lack of evidence indicating effectiveness. In some cases the presence of excessive soft tissue or proximity of blood vessels within soft tissue may necessitate the application of multiple tourniquets. Additional tourniquets (based on the severity of the injury) must be applied proximal to the initial tourniquet as closely as possible to the injury (Figure 3).

**Precautions.** Designed to compress tissue and blood vessels to cease ongoing blood loss of an extremity, tourniquet use is not without potential complications. The placement of a tourniquet produces extreme discomfort and pain at and distal to the site of application; however, many users underestimate the amount of pressure necessary to control hemorrhaging. Potential dangers of prolonged tourniquet application may include temporary or permanent injury to the underlying nerves and muscles. Systemic complications resulting from extremity ischemia include acidemia, hyperkalemia, arrhythmias, shock, and death. However, more recent studies have shown otherwise: There were no complications other than blood loss that were attributable to

<table>
<thead>
<tr>
<th>Tourniquet</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Bladder</td>
<td>Consists of an air bladder, pressure gauge/displaying bar, and inflatable device. A cuff that is too long or too short can cause problems. Individual manufacturers offer different sizes based on the size of the patient. Bladder is inflated with a squeeze bulb for final tightening.</td>
</tr>
<tr>
<td>Cargo-strap</td>
<td>2.5 cm wide and 55 cm long; consists of a ratchet, a buckle, and an elastic strap. Controls hemorrhage by inserting and pulling the strap along the ratchet and fastening the strap by the buckle.</td>
</tr>
<tr>
<td>Improvised</td>
<td>Canvas belts or cravats are often used as an example of an improvised tourniquet in textbooks. When cravats are used, a stick/ruler is used to wind up the cravat. Currently not recommended for use.</td>
</tr>
<tr>
<td>Rubber-tube</td>
<td>Rubber tube, 2 cm wide and 50 cm long, which is available in any surgical center.</td>
</tr>
<tr>
<td>Windlass</td>
<td>Varies based on manufacturer. Works by wrapping the device around the injured extremity, tightening the self-adhesive band, and twisting the windlass to achieve an appropriate pressure.</td>
</tr>
</tbody>
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*a Modified from Guo et al.27*
non-inappropriate tourniquet use in a study of 862 tourniquets applied on 651 limbs, as well as no identified complications related specifically to tourniquet use and no late neurologic injuries that could be clearly related to a tourniquet in a study of 80 tourniquets placed on 67 patients.

The restriction of blood flow results in both tissue hypoxia distal to the application site and anaerobic metabolism. When complications do occur, they are often related to tourniquet pressure and duration of occlusion, but there is insufficient evidence to determine a minimal critical time beyond which irreversible complications may occur. Limiting the application of a tourniquet to 2 hours will reduce complications and increases the ability to salvage the injured limb. If the extended time frame from initial care to more definitive care (ie, hospital) occurs, consultation with medical resources to consider tissue reperfusion may be considered. As a general rule, once the tourniquet is applied it remains constricted in place. Prior planning and access to medical control will be necessary to ensure positive outcomes.

Contraindications. The efficacy of placing a tourniquet is based on ability to restrict blood flow specifically to extremity injuries. Vascular compression over a joint is difficult due to mobility and risk of nerve damage. Thus, the application of tourniquets to other than isolated extremity injuries is contraindicated.

Device Design and Effectiveness

In the prehospital setting, the ideal tourniquet should be able to applied quickly and easily and offer effective occlusion of arterial and venous flow (Figure 4). It should also be...
simple, lightweight, compact, and of a rugged design to withstand a multitude of environments\textsuperscript{27,28} and should be applied before the signs of shock are evident\textsuperscript{14,16}. In terms of device effectiveness with placement, an awareness of application to the lower extremity may present anatomical challenges due to the presence of two bones. This may inhibit achieving adequate compression pressure on the artery or vein\textsuperscript{10,18}.

Regardless, tourniquet placement is just proximal to the injury and not over a joint. If bleeding is not controlled with the application of one tourniquet, a second may be applied just proximal to the first along with use of hemostatic agents and continued direct pressure.

Several types of devices meet this criterion, but not all devices are effective. Guo et al\textsuperscript{27} evaluated the use of 5 tourniquets to control blood flow. These included a (1) bladder tourniquet, (2) windlass tourniquet, (3) cargo-strap tourniquet, (4) rubber-tube tourniquet, and (5) improvised tourniquet (Table 4). A total of 20 participants self-applied each of the 5 devices. The bladder (upper extremities [UE] = 75\%, lower extremities [LE] = 100\%) and windlass tourniquets (UE = 80\%, LE = 100\%) effectively occluded arterial blood flow with success rates higher than 75\% in both the upper and lower extremities as measured by a vascular doppler ultrasound. The bladder tourniquet received the lowest score of pain, followed by the windlass tourniquet. The improvised tourniquet effectively occluded arterial blood flow in only 45\% of UE and 60\% of LE and produced the second highest pain score. Guo et al\textsuperscript{27} concluded that bladder and windlass tourniquets were efficient tourniquets; however, the windlass was superior with respect to portability and pain.

Currently, many field-durable windlass tourniquets are available in the marketplace for consumers. The Combat Application Tourniquet (C-A-T) (Composite Resources, Rock Hill, CA) is currently the device of choice for the US military and Canadian forces. The C-A-T has been shown to be superior to other tourniquets in controlling (minimizing) blood flow\textsuperscript{15,29}. Savage et al\textsuperscript{30} conducted a prospective controlled trial, comparing the efficacy and ease of applicability of 3 types of commercially available windlass tourniquets in 4 tactical situations on simulated patients. The overall finding of this study indicated that the C-A-T was applied the fastest in each scenario and was also significantly the most effective in occluding distal blood flow. Additionally, the C-A-T scored the highest in self-application by the participants.

**Application**

The general steps describing how to properly use a windlass tourniquet, specifically a C-A-T, are found in Table 6. For other types of devices, it will be necessary to follow the manufacturers’ recommendations. Once the device is placed on the patient, the athletic trainer should monitor the position and movement of the tourniquet and document the time of application and provide it to emergency medical providers upon arrival. A clinical assessment of adequate oxygenation and perfusion status is required using a pulse oximeter, with treatment based on clinical findings and patient history.\textsuperscript{3} Waiting for the pulse oximeter to indicate less-than-optimal tissue oxygenation places you, and the patient, in a reactive versus proactive response situation. Adequate ventilation and tissue perfusion\textsuperscript{2} should remain a priority regardless of the value obtained by pulse oximetry. Supplemental oxygen therapy should be administered to patients demonstrating...
signs of hypoxia to increase the overall amount of oxygen delivered to the body’s cells, thus increasing a patient’s chances of survival during an emergency.6

EDUCATIONAL CONSIDERATIONS

Equipment
As previously indicated, the use of tourniquets is not without potential complications. Educational opportunities that include understanding their use and provide for application in a simulated environment are beneficial. Early recognition of massive bleeding that cannot be controlled with direct pressure is paramount.

Today there are many different makes and models of tourniquets available in the marketplace. Figure 4 summarizes the ideal characteristics of a tourniquet; however, all devices should have the ability to apply adequate pressure to stop hemorrhaging. This pressure can be applied using a windlass mechanism (ie, C-A-T device), pneumatic mechanism (ie, bladder), clamp mechanism, ratchet mechanism, block-and-tackle mechanism, and elastic mechanism.

Most models use the windlass effect. Each commercial device comes with a different strap width, ranging from 2.5 to 9.1 cm. Tourniquets using a wider straps or cuffs help to distribute pressure more evenly and produce lower pressure gradients,31 are more likely to control hemorrhaging and less likely to cause damage to underlying tissue, and reduce pain compared with narrower straps and bands.28

Practicing tourniquet application in the prehospital or educational setting requires very little equipment—normally just a device and possibly an educational model. Devices range in price from $2.75 to $45.00 and are obviously contingent on the features attached to the unit as well as the quality of the device (Table 6).

Preparing to Teach the Skill
Participant practice with the tourniquet device(s) is highly recommended because various types of devices may have unique features of operation. To reduce the risk of injury, the use of simulation mannequin technology is preferable to practicing with live participants, primarily due to the risk of injury. Teaching the use of tourniquets is like teaching wound care: How do you teach the concept without having a student in need of a tourniquet or without having to spend money to buy another simulation mannequin/model? I have recently created a simulation model to demonstrate and practice the use of tourniquets in a very cost-effective manner using equipment located in the classroom.

Materials. The materials needed include:

1. a lower leg anatomical model
2. 5 zip ties
3. 3 lengths of 1.5 to 1.8 m silicon tubing, clear if it can be located
4. 0.63 × 22.8 × 22.8-cm foam sheet
5. 0.63 × 15.2 × 15.2-cm felt sheet
6. plastic wrap
7. 35 mL or larger syringe

Model Preparation. Begin creating the model by unscrewing the anatomical model at the knee joint. Measure the length of the silicon tubing so approximately 0.3 to 0.6 cm of extra tubing hang distally. This extra length helps prevent water from accumulating by allowing the water used in the tubing to drain into a reservoir. Lay the silicon tubing on the anteromedial aspect of the tibia. Using 3 zip ties, secure the silicon tubing (so snug that water cannot be pushed through it) to the tibia (2 ties) and the first metatarsal (1 tie). The distal end of the tubing can then be manipulated and secured behind the medial malleolus to create the posterior tibial artery. Snugly place 2 more zip ties about 1 to 2 inches apart in the middle of the tibia. These should be tighter than the distal and proximal ends. Making these middle 2 zip ties tighter occludes the tubing and when the tourniquet is applied will stop the flow of water.

Using a piece of 0.63 × 22.8 × 22.8-cm piece of felt (ours came from a multiple-size felt kit), wrap the felt around the tibia and fibula. Place the extra felt between the tibia and fibula, creating an artificial interosseous membrane (Figure 5). The felt padding placed between these structures helps to fill the void between the bones and prevents the weaker fibula from bowing in when the tourniquet is applied. Secure the felt with plastic wrap used to secure an ice pack to a patient’s body (Figure 6). Now, using the 0.63 × 15.2 × 30.4-cm piece of foam (ours came from a multiple-size foam kit), wrap the foam around the tibia and fibula and secure it with the plastic wrap...
Figure 7. Grab a bucket to collect water, because the model is now ready to be used to teach how to apply the tourniquet (Figure 8).

Teaching the Skills

Using a 35-mL (or larger) syringe, water (colored red if so desired), towels, and a reservoir to collect water, educators can now demonstrate severe bleeding. Attach the syringe to the proximal end of the tubing. Slow depress the plunger to move the water through the tube. Do not depress the syringe plunger too quickly—this will cause the syringe and tubing to separate. From here follow the skills steps for the application of a tourniquet found in Table 5.

CONCLUSION

The concepts of tourniquets should not be viewed as a challenge; rather, they should be viewed as an advancement of the profession and the device itself. The use of tourniquets by athletic trainers is not always within our foundational education for a variety of reasons. Having the requisite training on a fundamental life-saving skill is paramount given the likelihood of an athletic trainer being first on the scene of an emergency. In the presence of massive external hemorrhaging, early consideration of the use of tourniquets is appropriate following failure to control massive bleeding with direct pressure and a pressure bandage. Due to potential complications, education to include simulated application of these devices is necessary.

Part 2 of “Advanced Bleeding Control” will provide athletic training educators with evidence regarding the use of topical hemostatic agents in the prehospital setting as well as how to use and teach managing external hemorrhage using hemostatic agents within their educational programs.

REFERENCES


