An Ongoing Series

Improvised Inguinal Junctional Tourniquets

Recommendations From the Special Operations Combat Medical Skills Sustainment Course

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ABSTRACT

Effectively and rapidly controlling significant junctional hemorrhage is an important effort of Tactical Combat Casualty Care (TCCC) and can potentially contribute to greater survival on the battlefield. Although the US Food and Drug Administration (FDA) has approved labeling of four devices for use as junctional tourniquets, many Special Operations Forces (SOF) medics do not carry commercially marketed junctional tourniquets. As part of ongoing educational improvement during Special Operations Combat Medical Skills Sustainment Courses (SOCMSSC), the authors surveyed medics to determine why they do not carry commercial tourniquets and present principles and methods of improvised junctional tourniquet (IJT) application. The authors describe the construction and application of IJTs, including the use of available pressure delivery devices and emphasizing that successful application requires sufficient and repetitive training.

Keywords: tourniquets; tourniquets, improvised; hemorrhage, junctional; training; austere

Introduction

A substantial number of potentially survivable deaths on the battlefield are due to junctional hemorrhage.[1] Any effective and rapidly placed method of controlling significant junctional hemorrhage is an important effort of TCCC as stressed through the MARCH algorithm (Massive hemorrhage, Airway, Respirations, Circulation, and Head injury/Hypothermia).[2] Four devices currently exist that are FDA labeled and marketed for use as junctional tourniquets.[3] Most SOF medics are aware of the advances in hemorrhage control through training and exposure, but it remains unclear whether these junctional hemorrhage control devices are widely carried. Through ongoing course feedback and instructor/student ingenuity, we present some IJT principles and methods deemed potentially useful in the austere environment where robust packing lists are not feasible. These IJT methods were developed because of feedback from SOCMSSC students. This feedback indicates that many SOF medics do not carry commercially marketed junctional tourniquets (CJTs), due to cost, size, weight, and utility compared with other items with more potential utility. If the principles of junctional hemorrhage control are well understood, it is possible to recreate junctional tourniquets from everyday items, many of which the SOF medic has reliable access to in times of emergency.

Caution

Effective improvisation at any task requires a higher-level understanding in combination with ingenuity. Prior rehearsal is needed in order for improvisation to be achievable in times of combat and high stress when cognitive and fine motor skills are compromised. IJT construction and application take practice. Like all skills in medicine, the proper application of these devices is perishable. Multiple training sessions are necessary as competency at these skills can be achieved only through repetition. The principles described herein are intended as an example of what is possible for the medic or combatant who does not currently carry or have access to a CJT. TCCC guidelines describe the application of CJT in detail.[4]

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Background

SOCMSSC, housed at the Joint Special Operations Medical Training Center (JSOMTC), is the sole refresher for the Special Operations Advanced Tactical Paramedic (SO-ATP) certification. The course, 2 weeks in length, is conducted 22 times per year with an annual attendance capacity of just more than 1,300 SOF medics. SOCMSSC serves as a forum for discussion of techniques, experiences, treatment preferences, and lessons learned. SOCMSSC is where the lessons discussed below were discovered, refined, and broadcast back to the force. Some of the techniques and examples discussed have been applied in combat conditions and have resulted in the cessation of hemorrhage in casualties for whom no manufactured junctional tourniquet was available.

In this article, we try to expose the readers to the SOF philosophy and approach that supports the use of improvised devices, and in this case, IJTs. Some of the more commonly reported observations and experiences are described Table 1 and the following text.

TABLE 1 *Commonly Reported Observations and Experiences*

Observation/Principle	SOCMSSC Students' Descriptions
Multipurpose items are preferred	"All items in my aidbag must have more than one purpose."
Lightweight items add up	"I already have 300 lb of lightweight stuff to carry around."
Host-nation forces lack devices	"Host-nation forces do not have access to the same equipment, so we have to show them techniques with items they have on hand."
Cost is a consideration and trade-off	"How many hemostatic dressings, limb tourniquets, and cric kits could I buy for that much money?"
Truck and not ruck bag loadout appropriate	"I have a junctional tourniquet, but it's in my truck bag."
	"What do I have to give up to make room for this device?"

"All items in my aidbag must have more than one purpose." This is a mantra frequently overheard at the JSOMTC and applied throughout SOF battlefield medicine. This thought process informs every decision the SOF medic makes when packing an aidbag and offers more flexibility than a "single device per problem" approach. A long history of successful use of improvisational techniques reinforces the multipurpose mentality. SOF medics are often prized for a sense of rugged individualism and adaptability in less than ideal conditions. It is this perception of self that may also persuade medics to make do with less rather than seek out the perfect piece of equipment for each contingency.

"I already have 300 lb of lightweight stuff to carry around." Another quote often overheard at the JSOMTC. No matter how lightweight a single use item is, a surrogate item with multiple purposes will ordinarily appear more desirable to the SOF medic, even if that item weighs slightly more than the single-use item it is replacing. Terms like "cube and weight" are often used to describe the carrying capacity of the individual. These are strong considerations when planning and packing for a mission, especially when anticipating a long movement on foot.

"Host-nation forces do not have access to the same equipment we do, so we have to show them techniques with items they have on hand." SOF medics are often required to provide combat casualty care training to host-nation forces. Frequently, nations that need this type of assistance from the United States lack the means to purchase the same medical equipment. SOF medics must frequently demonstrate improvisational techniques using raw materials procured from local sources to maintain credibility with their partners.

"How many hemostatic dressings, limb tourniquets, and cric kits could I buy for that much money?" A cursory web search for commercially available junctional tourniquets reveals a price range between $300 and $700. Ideal circumstances call for unlimited budgets when purchasing life-saving equipment for battlefield use. The unfortunate truth is that cost *is* a factor in the procurement of medical gear, sometimes regardless of the proposed value to the preservation of life. Post–Global War on Terror (GWOT) budgetary considerations pose a looming threat to the acquisition of medical equipment. This frugality is increasingly evident in mission sets of a scale much smaller than seen during the height of the GWOT.

"I have a junctional tourniquet, but it's in my truck bag." The use of vehicle bags to tote junctional tourniquets may put distance and time between a dying casualty and the life-saving treatment they need. If the medic has instant access to the know-how and more rudimentary tools, that delay may be eliminated as a factor in casualty survival. A recent case in point came from a medic who received penetrating pelvic trauma while on patrol inside a structure near their vehicle convoy. In less than 30 seconds, the medic's pant leg was saturated with blood. The only individuals on the ground at the time were nonmedic Operators. The injured medic had cross-trained his team on improvised junctional tourniquets before deployment. One of the cross-trained Soldiers reached for the first object within arm's reach, which happened to be a stainless-steel coffee mug. He held the cup in place over the injury with his body weight while another teammate used a strap to secure it in place. This improvised junctional tourniquet resulted in a cessation of life-threatening hemorrhage, allowing the medic to survive through surgery and make a full recovery in the United States. No commercially manufactured junctional tourniquet was on site at the time of injury.

"What do I have to give up to make room for this device?" An aidbag is considered hallowed ground to a medic. Obsessive preparation and thought go into set-up and layout of the SOF medic's aidbag. All one has to do is reach into a medic's aidbag without first seeking permission in order to experience first-hand the painful consequences of having done so. Before a medic allows a new piece of gear into an aidbag that is to remain on the body, careful thought will have been put into the object's purpose and deployment in an emergency. Junctional tourniquets are not small items relative to the size of the typical aidbag. Their bulk is seen as a detrimental feature. In most cases, something will have to be removed in order to make room for such a large item, and medics often express an unwillingness to do so.

The steps and principles of improvised inguinal junctional tourniquets are summarized in Table 2 and the following descriptions.

1. **Apply manual pressure with a hemostatic first!**[4] This will consist of aggressive wound packing with a hemostatic,

TABLE 2 *Steps and Principles of Improvised Inguinal Junctional Tourniquets*

1. Apply manual pressure with a hemostatic.
2. Sole rescuers take a knee.
3. Select a pressure delivery device (PDD).
4. Position the tourniquet or strap over the apex of the gluteal muscle.
5. Like improvised TQs, the most reliable IJTs have a windlass.
6. Position the windlass medial of the apex of the PDD.
7. Remove all the slack before tightening the windlass.
8. Take up tourniquet slack in a pushing motion across the patient's body.
9. Junctional tourniquets move during transport.

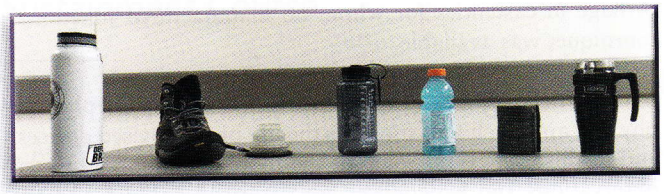
followed by either a knee or a fist placed squarely in the inguinal gutter on the injured side. Pack the wound with an approved hemostatic followed by direct pressure. This step is crucial and can afford the casualty precious time while tourniquet preparations are made. Faltering on this principle may result in the exsanguination of the casualty prior to application of the tourniquet. Manual pressure during casualty movement may be difficult or impossible to maintain, therefore it is of the utmost importance to apply a junctional tourniquet at the earliest opportunity. The inguinal gutter is the linear crease between the top of the thigh and the lower abdomen with the vascular structures located midway between the pubic symphysis and anterior superior iliac spine (Figure 1).

FIGURE 1 *Manual pressure in the inguinal gutter.*

2. **Sole rescuers take a knee.** If the rescuer is alone, preferably use a knee in the inguinal gutter in order to have two hands free to prepare the IJT. Palpating distal pulses or with the use of a Doppler as described later can refine the best pressure location of this technique. If pelvic fracture is suspected, the rescuer must weigh the importance of hemorrhage control over the potential for further harm through manipulation of a fractured pelvis (Figure 2).
3. **Select a PDD.** An object that fits into the inguinal gutter and can remain stable is half of the solution. The object will usually be something either cylindrical or spherical. Munitions or pyrotechnic devices should never be used as the PDD (Figure 3).
4. **Position the tourniquet or strap over the apex of the gluteal muscle.** The apex of the gluteal muscle is the top part of the buttocks and this prevents the strap from sliding off

FIGURE 2 *Lone rescuer with two free hands after taking a knee in the inguinal gutter.*

FIGURE 3 *Potential PDDs.*



inferiorly. From our experience, this step focuses the PDD at the point most likely to cut off blood flow as measured by Doppler (Figure 4).
5. **Like improvised TQs, the most reliable IJTs have a windlass.**[5] Attempts with everything from pelvic binders to tactical compression (Murphy) wrap in our training have all led to the same conclusion: there always needs to be a windlass in order to succeed at IJT application. Ratcheting tourniquet mechanisms have shown promise but have been insufficiently evaluated at SOCMSSC to provide comment.

FIGURE 4 *Placement of tourniquet over the apex of the gluteal muscle.*

6. **Position the windlass (depicted by red line) slightly medial of the apex of the PDD.** This discovery was made during the many thousands of repetitions at IJT training during SOCMSSC, especially with cylindrical or curved PDDs. These observations were made purely by trial and error and not through any structured research processes. This step most consistently directs the PDD toward the femoral artery and prevents it moving more posteriorly compared to pressure directly over or lateral to the apex (Figure 5).
7. **Remove all the slack before tightening the windlass.** Failure to take up all the slack is the number one reason for tourniquet failure.
8. **Take up tourniquet slack in a pushing motion across the patient's body.** Tourniquet slack can be difficult to take up when pushing a small amount of strap into the ground or a

FIGURE 5 *Placement of windlass in relation to apex of PDD.*

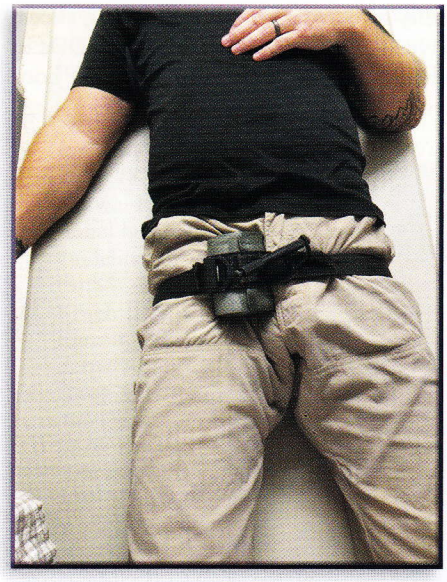


FIGURE 7 *SOFTT-W with tightly rolled SAM Splint.*

litter. It is for this reason that pushing the slack out across the patient's body makes for less complicated application (Figure 6).

9. **Junctional tourniquets move during transport.**[6] No junctional tourniquet, whether commercial or improvised, travels well. Junctional tourniquet placement must be confirmed by visual inspection and distal pulselessness, at regular intervals and after any movement.

FIGURE 6 *Taking out all the tourniquet slack prior to turning the windlass. Failure to perform this step is the number one reason for tourniquet failure.*

Examples of Improvised Junctional Tourniquets

SOF Tactical Tourniquet-Wide (SOFTT-W) tourniquet and tightly rolled SAM splint (or other suitable PDD): Medics throughout SOF are intimately familiar with both items. At 41 inches (104 cm), the SOFTT-W is typically long enough to be wrapped around the waist, making it an obvious choice over other options. The SOFFT-W is preferred due to its wider profile that provides additional stability. At 37.5 inches (95 cm), Combat Application Tourniquets® (C-A-T) tend to be too short to wrap around the average adult waist by themselves and therefore must be doubled up in most cases if used in place of the SOFFT-W (Figure 7).

Two cravats, water bottle, and trauma shears: Of all the examples shown, this one is the most versatile. Other items can replace every suggested object in this IJT if they can withstand the tension, pressure, and torque required for success. The question of "exactly how much torque is required?" can be answered by training the task to the point that the rescuer repeatedly demonstrates the ability to eliminate distal pulses (Figures 8–10).

FIGURE 8 *Two cravats square knotted onto the casualty. One around the waist, the other around the thigh on the injured side.*

FIGURE 9 *Slide water bottle or selected PDD under both cravats. The PDD will naturally come to rest in the inguinal gutter slide windlass between the PDD and the cravats. The axis of the spinning windlass should be just medial of the apex of the PDD.*

FIGURE 10 *Turn the windlass until distal pulse has been eliminated and secure the windlass with the tails from the two cravats.*

SOFTT-W with casualty's boot. Tactical boots, hiking shoes, and low top hikers have all been successfully used as PDDs in training. This option has value for instances in which the boot has not been destroyed or lost due to blast (Figure 11).

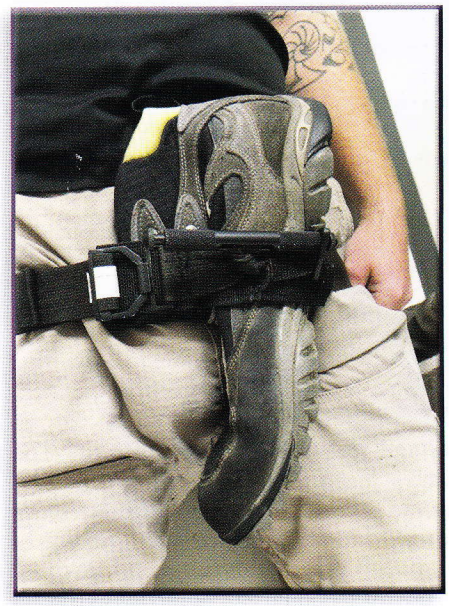


FIGURE 11 *Use of a tactical boot as a PDD. Note the IJT windlass placement is just medial to the apex of the PDD.*

Improvised Junctional Tourniquets Training

The simplest and most valuable addition any unit can make to hemorrhage control training is a vascular Doppler with an 8-MHz probe. If purchased on the internet, it costs an average of $100. This indispensable tool amplifies and measures the elimination of an audible arterial pulse to the site of IJT application. IJT training is not the only application in which a vascular Doppler is useful. They are also ideally suited for limb tourniquet application, commercial junctional tourniquet application, and measuring the effectiveness of manual pressure.

1. Apply ultrasound gel to the vascular probe.
2. Locate pulse at either the dorsalis pedis or the posterior tibialis.
3. Dial the Doppler volume up for the benefit of all trainees in attendance.
4. Firmly anchor the Doppler with wrist against the casualty's appendage to protect signal integrity during IJT application.
5. Verify the absence of a pulse after application of manual pressure.
6. Have the trainee apply and secure the IJT while simultaneously maintaining pulselessness with manual pressure.
7. Release tourniquet after pulselessness is demonstrated, then rotate provider and casualty roles through trainees until all trainees can reliably demonstrate competence at IJT application.

Training goals – At SOCMSSC the training goal is to have an IJT secured on the casualty with demonstrated pulselessness in under 1 minute.

Manual palpation can also be used to determine the successful elimination of distal pulses at both the dorsalis pedis and posterior tibialis locations. Although audible pulses may be ideal, a palpable pulse detection in training has the distinct advantage of a low price and universal accessibility. The trainer must make every effort to confirm that trainees are actually eliminating pulses versus attempting to spare the casualty from the discomfort of having an IJT correctly applied.

Properly applied tourniquets hurt, but the use of Doppler can limit pain[7] – This unavoidable aspect of tourniquet training should not serve as an obstacle to the achievement of competence in hemorrhage control. Avoidance of pain in tourniquet training may prove detrimental to future casualties for whom survival depends on rescuers who are familiar with the techniques of external hemorrhage control measures.

"Finesse comes with reps" – Rescuers who have achieved competence with the subtle nuances of IJT application may achieve a decrease in IJT related discomfort.

Who Should Learn to Apply Improvised Junctional Tourniquets?

All SOF combatants need training to manage junctional hemorrhage by all means available. The outcome of junctional hemorrhage in combat is often dire and requires decisive action on the part of properly trained individuals. Successful application of thousands of junctional tourniquets both improvised and commercial in SOCMSSC have made it apparent that junctional hemorrhage control appears to be within the grasp of all who make an attempt, provided the training is sufficient to support success.

Cross training of nonmedics throughout SOF is critical to casualty survivability. All SOF Operators should be trained to control junctional hemorrhage as it remains a major source of preventable battlefield mortality. While commercially developed products remain the standard of care, improvised junctional hemorrhage control devices can be a combat multiplier to the SOF Operator when these devices are not available.

What Is History Telling Us?

In the early years of the GWOT, limb tourniquets were regarded with fear and suspicion. Their construction was rudimentary, usually homemade from cloth and a stick of some sort to act as a windlass. Tourniquets were widely considered an intervention of last resort, and their use associated with inevitable limb loss. Meanwhile, SOF medicine universally embraced the use of tourniquets and viewed them as a primary intervention for life threatening extremity hemorrhage. Almost 18 years later, the use of extremity tourniquets has spread into almost every aspect of civilian trauma care. All US military units, conventional and Special Operations, deploy to combat zones with at least one tourniquet per Soldier. Sharing this knowledge with our civilian counterparts, especially to law enforcement agencies, first responders, and nongovernment organizations, is extremely important in ensuring maximal prehospital hemorrhage survival.

- ***Lifesaving hemorrhage control can and should be performed by everybody if the proper training is provided.***[8]
- ***Lessons in battlefield hemorrhage control which transition from SOF to conventional forces may stand a better chance of surviving after the drawdown of an armed conflict.***
- ***Lessons in battlefield hemorrhage control which transition to civilian practice may stand a greater chance of***

remaining first line interventions for the early years of the next armed conflict.[9,10]

An Army command sergeant major who regularly attended SOCMSSC until his retirement after 30 plus years in SOF, recalled his first SF team in the '70s. This team was composed mostly of Vietnam veterans and had a standard operating procedure that dictated that during deployments each teammate carry an extra-long web belt along with a canteen. This SOP was an early example of junctional hemorrhage management before the term "junctional hemorrhage" had been coined.

- ***Lessons learned regarding hemorrhage control will be forgotten if their importance goes unrecognized.***

Finally, casualty response is not only a medical emphasis but an overall emphasis of the operational leadership and requires integration into comprehensive and realistic training scenarios and should be considered a core training requirement of all organizations (military and civilian) that encounter casualty-producing events.[11]

Disclaimer

There are no relevant financial conflicts of interest to disclose. The listing of devices by brand name does not constitute endorsement on the part of the author. Any preference shown towards one device over another was a genuine attempt at providing the most useful information to the force from what was currently available.

Disclosure

The authors have nothing to disclose.

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