# Re-Evaluating the Field Tourniquet for the Canadian Forces

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**ABSTRACT** Objective: To determine the best field tourniquet for Medical Technician (Med Tech) use in the Canadian Forces (CF). Methods: We 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 primary outcome was time to tourniquet application with secondary outcomes including effectiveness and Med Tech satisfaction. Results: The overall finding of this study indicates that the Combat Application Tourniquet (C-A-T) was applied the fastest in each scenario and was also significantly the most effective in occluding distal blood flow. The survey results show that the 3 tourniquet types are similar in many of the measures of ease of learning and application, with the C-A-T scoring highest in self-application and the Special Operations Forces Tactical Tourniquet Wide having the lowest scores for both durability and effectiveness. Conclusion: When tested on a group of CF Med Techs, the C-A-T remained the CF field tourniquet of choice, based on the assessed criteria. Although there is inherent bias in the approach of this study, it reflects the process required to determine if a new piece of kit is superior to what is already considered the standard to a trained and equipped military.

## INTRODUCTION

The principles of Tactical Combat Casualty Care are the backbone of current battlefield medicine.[1] Within those principles, the management of massive extremity hemorrhage is addressed by initial tourniquet application. This decision was made based on data collected from the Korean and Vietnam Wars indicating that hemorrhage from extremity trauma was the leading potentially preventable cause of death on the battlefield.[2]

There is now compelling evidence from operations in Iraq and Afghanistan to show that tourniquets save lives, especially when applied before the onset of shock.[3–5] Furthermore, the benefits of tourniquet use have been shown to outweigh the risks of their use in the military environment.[6,7] The Canadian Forces (CF) initially started out using surgical tubing as improvised tourniquets; these worked on the basis of the elastic action of the tubing.[8] Now, the CF has adopted a commercially available tourniquet that uses a windlass mechanism of action, and that has been shown to be field durable, user friendly, and highly effective in both the laboratory and the battlefield setting. Currently, every CF solider who deploys carries at least one commercially available windlass tourniquet. The majority carries the Combat Application Tourniquet (C-A-T) (Composite Resources, Rock Hill, South California).

There are currently many field-durable windlass tourniquets available on the market. Selecting the appropriate tourniquet is critically important, as not every tourniquet may be effective on the battlefield [9–11] In Canada, the initial decision to select the C-A-T as the tourniquet of choice was partially based on human volunteer studies done by the U.S. Army Institute for Surgical Research. These studies showed that the C-A-T was superior to 9 other candidate tourniquets, as a result of careful laboratory testing on human volunteers and field testing by army medics. Tourniquets were scored for effectiveness by Doppler testing, and for pain, using an analog pain scale.[12]

Many lessons have been learned about tourniquet use on the battlefield that impact on the process for tourniquet selection. In fact, some of the initial assumptions on the ideal battlefield tourniquet were found to be less important, with accumulated experience. For example, Kragh, et al[13] found that the desirable trait of a one-handed design for self-application was rarely ever used on the battlefield. As well, other issues have been reported by field medics concerning the effectiveness of tourniquets on larger thighs, the impact of soil on the self-ratcheting mechanism, and the amount of pain associated with specific tourniquet brands.[13] As a result, some Canadian military members have adopted other tourniquet brands on an ad hoc basis, particularly the Special Operations Forces Tactical Tourniquet (SOFTT) (Tactical Medical Solutions, Anderson, South California) and the Special Operations Forces Tactical Tourniquet Wide (SOFTT-W) (Tactical Medical Solutions, Anderson, South California). On an organizational level, however, adopting a new tourniquet would involve both the cost required to change over thousands of tourniquets and the time to adjust training plans for all CF soldiers.

All 3 tourniquets have been shown to be effective in laboratory studies.[9,14] However, these have been conducted under very controlled circumstances that may not mirror those of real-life application on the battlefield. In this study, we developed field scenarios to assess battlefield tourniquets that would mirror real-life scenarios faced by CF Medical Technicians (Med Techs) on operations. The purpose of the study was then to compare performance of 3 types of tourniquets frequently used by CF to determine the best tourniquet for Med Tech use in the CF.

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## METHODS AND MATERIALS

### Study Design

We conducted a prospective controlled trial with 3 arms, comparing the efficacy and ease of applicability of 3 types of commercially available windlass tourniquets in 4 tactical situations on simulated patients, using a repeated measures design. Med Techs applied each type of tourniquet on to simulated patients. The order of the type of tourniquets was randomly determined; however, the scenarios were prioritized in order of importance, in the event of an early termination of the study because of pain. Outcomes were assessed and each Med Tech served as both health care provider (applied the tourniquet) and simulated patient (for another Med Tech). When in the role of simulated patient, the Med Tech was not blinded to the type of tourniquet being applied.

The 4 tactical scenarios were generated using a combination of lessons learned on the battlefield as to the most difficult scenario to apply a tourniquet, along with a major strategic focus of the CF to be able to operate in the Arctic. The top 4 scenarios were selected by agreement, after discussion among the study investigators.

### Inclusion Criteria

After being approved by Defence Research & Development Canada Toronto Human Research Ethics Committee, 22 CF Med Techs, from 2 medical field units located at CF Base, Petawawa, were recruited to participate in the study. The sample size was a convenience sample of Med Techs who were available and willing to participate. Med Techs in the CF are between the ages of 18 and 55 (as there is mandatory retirement at the age of 55 years) and by definition, the rank restriction for this study was Private to Sgt, as Med Tech with a higher rank than Sgt would be classified as a Physician Assistant. Med Techs were chosen as study participants as they are the equivalent to the paramedic of the CF. They are responsible to provide medical care at the point of injury and are responsible for the initial stages of evacuation. Thus, they represent the CF member most apt to apply a tourniquet in the field, and they are also responsible for training nonmedical CF members on how to apply a tourniquet.

### Exclusion Criteria

Participants were initially briefed by the primary author on the purpose of the study, its design, and associated risks. After obtaining consent, they were medically screened and cleared by a Physician Assistant. Participants were excluded if they had any of the following conditions: prior extremity venous or arterial blood clot, poor circulation as defined by the health care provider performing the medical screening, ongoing or chronic infection of the extremity, an open wound or recent trauma to the extremity, or muscle injury of the extremity within the preceding 4 weeks. All female Med Techs were screened for pregnancy using qualitative urine beta human chorionic gonadotropin and were excluded if the result was positive. None of the Med Techs initially screened met any of the exclusion criteria.

### Intervention

We compared 3 types of tourniquets:

(1) C-A-T: Combat Application Tourniquet (Composite Resources, Rock Hill, South California), which was considered the control arm
(2) SOFTT: Special Operations Forces Tactical Tourniquet (Tactical Medical Solutions, Anderson, South California)
(3) SOFTT-W: Special Operations Forces Tactical Tourniquet Wide (Tactical Medical Solutions, Anderson, South California)

### Study Procedure

Med Techs are trained in the application of tourniquets. However, before the study, all Med Techs participated in a training session on how to properly apply each type of study tourniquet. Participants were briefed on each tourniquet and taught how to apply the tourniquet using the directions printed on the product monograph as the standard method. Med Techs were allowed to handle, inspect, and practice applying the tourniquet for as long as was required so that they felt comfortable with its use. Study participants were subsequently divided in 11 teams of 2 and were then assigned to the 4 tactical scenarios in a prioritized manner. One Med Tech was assigned to be the health care provider and the other was assigned to be the simulated patient. The order of the type of tourniquet applied was randomly determined. Outcomes were assessed by study authors (Terrance O'Leary and Erin Savage), and then the roles of the Med Techs were reversed, and the procedure repeated. Medical teams then rotated through each of the different tactical scenarios, and tourniquet application was assessed. In all cases, each Med Tech applied each tourniquet once in each tactical scenario. This resulted in each Med Tech applying 12 tourniquets in total. At the end of this process, Med Techs then anonymously completed the survey to assess satisfaction with a tourniquet and with patient satisfaction of the tourniquet.

### Scenarios

Tourniquets application was performed in 4 different tactical scenarios. The 4 tactical scenarios were generated using a combination of lessons learned on the battlefield as to the most difficult scenario to apply a tourniquet, along with consideration of a strategic focus of the CF to operate in the Arctic and were prioritized in order as below. The study investigators agreed on the ranking of the top 4 scenarios. The 4 scenarios were the following:

(1) Application of a tourniquet to their partner's thigh over combat pants in the field.
(2) Application of a tourniquet to their partner's thigh over combat pants while they were seated in a Generation III

**FIGURE 1.** Tourniquet application to a casualty in an armored vehicle.

Light Armoured Vehicle (General Dynamics Land Systems, London, Ontario) (Fig. 1).

(3) Application of a tourniquet to their partner's lower leg in a Winter Warfare environment. The injured CF members would be wearing CF issued fleece and wind pants to simulate cold weather gear, whereas the Med Tech applying the tourniquet would be dressed in warm weather gear.
(4) Self-application of a tourniquet to their own arm.

### Outcome

The primary outcome was time to tourniquet application. Time to tourniquet application was measured by a stop watch, to the nearest second. Start time began with the assessor saying "start." Stop time was determined by the Med Tech saying "done."

Secondary outcomes included the following:

(1) Effective placement that was determined by absence of pulse, both with manual palpation and with a handheld Doppler (Nicolet Vascular, Madison, Wisconsin, IMEX Pocket Dop II, 3 MHz) placed directly on skin. Note: A pulse check was not performed during the armored vehicle scenario as it would have involved the participants climbing in and out of the armored vehicle with a tightened tourniquet on their leg, which increased risk to the participants.
(2) Med Tech satisfaction and patient satisfaction. Med Tech satisfaction was assessed using an anonymous survey technique, where satisfaction was assessed by 7 questions, and graded using a 5-point Likert scale (Strongly Agree, Agree, Neither Agree or Disagree, Disagree, and Strongly Disagree). The 7 questions were the following:
    (1) It is easy to learn how to use this tourniquet.
    (2) It is easy to apply this tourniquet to a casualty in front of me.
    (3) It is easy to apply each tourniquet to a driver of an armored vehicle.
    (4) It is easy to apply this tourniquet to someone wearing cold weather clothing.
    (5) It is easy to apply this tourniquet to myself.
    (6) This tourniquet is durable.
    (7) This tourniquet is effective.

Patient satisfaction was assessed by the degree of pain that patients experienced with tourniquet application. This was graded using an anonymous survey using a 5-point Likert scale (No Pain, Minor Pain, Moderate Pain, Severe Pain, and Could Not Tolerate).

### Statistical Analyses

A univariate two-way repeated measures analysis of variance (ANOVA) was used to compare the time required to apply 3 different types of tourniquets across the 4 scenarios and to examine the differences in effectiveness of application of each tourniquet. Given the repeated measures study design, Mauchly's test of sphericity was examined and a Greenhouse–Geisser correction of the degrees of freedom was employed, as required, to correct for any violations in sphericity detected. Post hoc pairwise comparison using a Bonferroni correction to account for multiple comparisons was used to further detect statistically significant differences between groups. A $p$ value of less than or equal to 0.05 was used as a criterion for all significance testing. Med Tech and patient satisfaction survey results were summarized using descriptive statistics.

All analyses were conducted using SPSS version 18.

## RESULTS

### Time to Application

The mean differences in time to application of the 3 tourniquets in 4 different scenarios were examined. The ANOVA showed that there was a significant main effect of tourniquet type on time to application $F(2, 42) = 12.46$, $p < 0.001$. Significance testing indicated that the mean amount of time required to apply the SOFTT and the SOFTT-W was significantly longer than the time to apply the C-A-T (Table I) while there was no significant difference in the time to application between the SOFTT and SOFTT-W. The standard deviations suggest that there was much greater variability in the time to application for both the SOFTT and SOFTT-W tourniquets.

Mauchlys' test indicated that the assumption of sphericity had been violated for the scenario variable ($\chi^2$ (5) = 16.91,

**TABLE I.** Time to Tourniquet Application by Type

| Tourniquet Type | Statistical Significance | | |
|---|---|---|---|
| | Overall Mean | SD | $p$ Value |
| C-A-T | 33.8 | 10.9 | Reference |
| SOFTT | 48.2 | 20.3 | $p < 0.001$ |
| SOFTT-W | 45.0 | 24.8 | $p = 0.003$ |

$p = 0.005$) and the interaction variable ($\chi^2$ (20) = 58.91, $p < 0.001$). Greenhouse–Geisser estimates of sphericity for scenario ($\varepsilon = 0.63$) and the interaction of scenario and tourniquet variables ($\varepsilon = 0.52$) were therefore used.

The ANOVA results showed that the scenario under which the tourniquet was applied did not have a significant main effect (F (1.87, 39.36) = 2.06, $p = 0.144$) on time to apply the tourniquet. However, there was a significant interaction effect of scenario and tourniquet type (F (3.12, 65.52) = 6.25, $p = 0.001$), indicating that mean time to application in each scenario differed significantly by tourniquet type (Table II). The C-A-T application time was consistently the shortest, across all scenarios, and pairwise comparison confirmed that the difference was significant when compared to the SOFTT in scenarios 1, 2, and 4 and SOFTT-W in scenario 4.

### Effectiveness of Tourniquet Application

During one scenario, one SOFTT-W malfunctioned before the distal pulse was assessed; consequently, this event was not included in this analysis. The final sample sizes for each scenario were as follows: scenario 1 (thigh over combat pants), $N = 21$; scenario 2 (lower leg over cold weather clothing), $N = 22$; and scenario 4 (self-application), $N = 22$. Effective placement was not assessed in scenario 3 for patient safety reasons.

When examining differences in effectiveness of application by tourniquet type, Mauchlys's test indicated that the assumption of sphericity had been violated ($\chi^2$ (2) = 11.46, $p = 0.003$), thus Greenhouse–Geisser estimates ($\varepsilon = 0.70$) were used. There was a significant main effect of tourniquet type on effectiveness of application (F (1.39, 29.24) = 7.71, $p = 0.005$). The C-A-T tourniquet prevented distal blood flow in 97.0% of cases. Significance testing indicated that the C-A-T was significantly more effective than either the SOFTT, which was effective in 72.7% of cases ($p = 0.001$) or the SOFTT-W, which was effective in 73.8% of cases ($p = 0.001$).

When examining differences by scenario, the ANOVA showed that there was a significant main effect of scenario on effectiveness of application (F (2, 42) = 6.88, $p = 0.003$). The self-application scenario had the lowest effectiveness, preventing distal blood flow in 68.2% of applications. Self-application effectiveness was significantly lower compared to tourniquet application to thigh over combat pants (scenario 1), which was effective in 89.2% of cases ($p = 0.019$) and the application to a lower leg over cold weather clothing (scenario 3), which was effective in 86.4% of cases ($p = 0.013$).

### Patient and Med Tech Satisfaction Survey Findings

All study participants completed the survey ($N = 22$). The survey findings are summarized in Tables III and IV.

The ease of learning survey responses were positive for all tourniquet types. The small standard deviations indicate that there was not much variability in responses (Table III).

Four questions were used to assess the ease of application of the various tourniquets in the different scenarios (Table III). All tourniquets had a positive response for ease of application to a casualty in front of the participant as well as a casualty seated in an armored vehicle. All tourniquets received a positive response for ease of application over cold weather. However, when asked about self-application, only a minority of people found the SOFTT and SOFTT-W easy to apply to their own arm. Conversely, the C-A-T received a clear positive response.

The C-A-T and SOFTT received similar and positive responses to the statement "This TQ is durable." However, only a minority of people found the SOFTT-W to be durable (Table III). There was some variability in response in terms of the effectiveness of the tourniquets. The C-A-T received the strongest positive response as to its effectiveness (Table III).

The percentage of people who responded that they had levels of pain that were intolerable or severe was twice as high for the C-A-T as for the SOFTT or the SOFTT-W (Table IV).

## DISCUSSION

The overall finding of this study indicates that the C-A-T was the tourniquet that could be applied the fastest in each

**TABLE II.** Time to Tourniquet Application by Type and Scenario

| No. | Scenario | Tourniquet Type | Time in Seconds | | Statistical Significance |
|---|---|---|---|---|---|
| | | | Mean | SD | $p$ Value |
| 1. | Thigh, Over Combat Pants | C-A-T | 33.2 | 6.7 | Reference |
| | | SOFTT | 45.0 | 18.4 | $p = 0.014$ |
| | | SOFTT-W | 37.2 | 17.1 | $p = 0.982$ |
| 2. | Thigh, Over Combat Pants in Armored Vehicle | C-A-T | 41.1 | 11.4 | Reference |
| | | SOFTT | 50.9 | 19.1 | $p = 0.037$ |
| | | SOFTT-W | 43.1 | 23.4 | $p = 1.00$ |
| 3. | Lower Leg, Over Cold Weather Clothing | C-A-T | 37.0 | 10.2 | Reference |
| | | SOFTT | 45.4 | 17.7 | $p = 0.189$ |
| | | SOFTT-W | 38.1 | 11.3 | $p = 1.00$ |
| 4. | Arm, Self-Application | C-A-T | 24.1 | 7.0 | Reference |
| | | SOFTT | 51.6 | 25.4 | $p < 0.001$ |
| | | SOFTT-W | 61.7 | 34.3 | $p < 0.001$ |

**TABLE III.** Survey Results: Participant Opinions of Ease of Learning, Application, Durability, and Effectiveness

| No. | Survey Question | Tourniquet Type | Median | Mean | SD | Percent Positive Response (Strongly Agree or Agree) |
|---|---|---|---|---|---|---|
| 1. | It Is Easy to Learn How to Use | C-A-T | 5.0 | 4.9 | 0.3 | 100.0 |
| | | SOFTT | 4.0 | 4.2 | 0.7 | 86.4 |
| | | SOFTT-W | 5.0 | 4.6 | 0.5 | 100.0 |
| 2. | It Is Easy to Apply to a Casualty in Front of Me | C-A-T | 5.0 | 4.8 | 0.7 | 95.5 |
| | | SOFTT | 4.0 | 4.1 | 0.8 | 90.9 |
| | | SOFTT-W | 4.0 | 4.4 | 0.6 | 95.5 |
| 3. | It Is Easy to Apply to a Driver of an Armored Vehicle | C-A-T | 4.0 | 4.3 | 0.6 | 90.1 |
| | | SOFTT | 4.0 | 3.7 | 1.0 | 72.7 |
| | | SOFTT-W | 4.0 | 4.0 | 1.1 | 81.1 |
| 4. | It Is Easy to Apply to Someone Wearing Cold Weather Clothing | C-A-T | 5.0 | 4.8 | 0.4 | 100.0 |
| | | SOFTT | 4.0 | 4.0 | 0.7 | 86.2 |
| | | SOFTT-W | 4.0 | 4.1 | 0.8 | 86.4 |
| 5. | It Is Easy to Apply to Myself | C-A-T | 5.0 | 4.9 | 0.4 | 100.0 |
| | | SOFTT | 2.0 | 2.5 | 1.2 | 31.8 |
| | | SOFTT-W | 2.0 | 2.6 | 1.3 | 31.8 |
| 6. | Opinion of Durability | C-A-T | 4.0 | 4.2 | 0.8 | 86.4 |
| | | SOFTT | 4.0 | 4.3 | 0.6 | 90.1 |
| | | SOFTT-W | 3.0 | 2.9 | 1.2 | 27.3 |
| 7. | Opinion of Effectiveness | C-A-T | 5.0 | 4.8 | 0.4 | 100.0 |
| | | SOFTT | 4.0 | 3.9 | 0.7 | 77.3 |
| | | SOFTT-W | 4.0 | 3.6 | 0.9 | 54.5 |

scenario and was also significantly the most effective in occluding distal blood flow.

It is interesting that one particular scenario, self-application to the arm, showed to be extremely challenging. Overall, tourniquets were less effective and the time to application was less consistent when patients had to self-apply them. The percentage of effectively applied tourniquets was significantly lower in the self-application scenario. This may have been related to pain of tourniquet application and the hesitancy for the casualty to tighten the tourniquet to effectiveness. It is always a debate as to the importance of choosing a tourniquet that is easy to self-apply to the arm; on the one hand, soldiers feel more confident knowing they can manage an upper extremity massive hemorrhage on their own. On the other hand, the CF have never had a confirmed case of self-application of an upper extremity tourniquet. Ease of self-application has traditionally been a key requirement for any potential new candidate battlefield tourniquet. Although usage data suggests that self-application does not commonly happen on the battlefield, soldier morale issues will likely continue to drive this ongoing requirement for new tourniquet selection. Our study suggests that ease of self-application remains a way to distinguish different brands of tourniquets and that training should acknowledge pain expected with tourniquet application. The C-A-T tourniquet was the easiest to self-apply in our study.

The survey results show that the 3 tourniquet types are similar in many of the measures of ease of learning and application, with the exception of application to self. In the ease of self-application, the C-A-T scored much higher than either SOFTT or SOFTT-W, which corresponds to the time to application findings. In terms of both durability and effectiveness, the SOFTT-W had the lowest mean score and lowest percent of people responding positively. Finally, although the mean score for the pain experienced was similar across the 3 tourniquet types, the percent that reported an extreme negative response was twice as high for the C-A-T, compared to the SOFTT or SOFTT-W.

Despite the fact that massive extremity hemorrhage is recognized as the number one cause of potentially preventable death on the battlefield,[2,15] it has only been during the current conflicts in Iraq and Afghanistan that prehospital tourniquet application has been embraced. Data exist, both within the CF and the United States, that prehospital tourniquets save lives[3–5,16] and have relative minimal morbidity.[6,7]

The endeavor to improve medical care and equipment should never cease. However, the urge to transition to every

**TABLE IV.** Survey Results: Participant Experience of Pain

| Survey Question | Tourniquet Type | Median | Mean | SD | Percent Extreme Negative Response (Could Not Tolerate Pain or Severe Pain) |
|---|---|---|---|---|---|
| 8. Experience of Pain | C-A-T | 3.0 | 3.0 | 0.7 | 18.2 |
| | SOFTT | 3.0 | 3.4 | 0.8 | 9.1 |
| | SOFTT-W | 3.0 | 3.3 | 0.8 | 9.1 |

new piece of equipment that becomes available on the market requires new training for an entire military force, and a significant fiscal cost to replace all the items within the system. This "cost" needs to be objectively reviewed to ensure that the new equipment is superior to what is being replaced, which is what we attempted to accomplish with this study.

Direct comparisons of tourniquets are extremely few in the literature. Taylor, et al[17] determined that the Emergency and Military Tourniquet (EMT) was superior to the C-A-T application at mid-thigh when tested in 24 military members in a clinic environment. Though the pneumatic EMT is an outstanding tourniquet, and has been found to be the superior Emergency Department tourniquet,[6] it is larger, heavier, and less robust than windlass tourniquets.[5] Because of these limitations, the CF has chosen to ensure the EMT is present on ambulance platforms and in Forward Operating Bases, where its role is largely one of tourniquet conversion. Indirectly, the C-A-T has shown its performance as an excellent tourniquet as it is the primary tourniquet in use in the U.S., Canadian, and Israeli Defense Forces.[6,16,18]

## LIMITATIONS

The most obvious and significant limitation with the study is the inherent bias of testing a new tourniquet with participants who have been introduced and trained previously with the other tourniquets involved in the trial. The SOFTT and, in particular, the C-A-T have been in used in the CF for a period of time, which may have placed the SOFTT-W at a disadvantage in comparison. Although the study participants were junior Med Techs, actual demographics regarding their prior knowledge and experience with the C-A-T and SOFTT was not captured, so could not be used in the data analysis. Although each participant received identical training on each of the tourniquets examined in the study, it is possible that previous exposure to particular tourniquet type may have improved the application speed and effectiveness.

Another significant point is that the SOFTT-W tourniquet design has changed since the study was completed. The initial SOFTT-W was composed of a thinner more flexible nylon material that was less durable and bunched easily, making the tourniquet less effective. The nature of the material also was very slippery/smooth causing difficult self-application to the arm. In fact, the malfunction of one of the SOFTT-W during data collection was due to the stitching holding the windlass tearing resulting in the windlass completely separating from the tourniquet. Since data collection, material fabrication of the SOFTT-W has been changed to match that of the SOFTT, ensuring durability and width that could make the tourniquet more effective and easier to apply. Of note, one of the concerns with both the SOFTT and SOFTT-W is the triangle shaped fasteners that the windlass is hooked into to hold the tourniquet tight. Incidentally, many of the participants struggled with this type of fastener as it can take significant upper extremity strength to accomplish when tight. Occasionally, participants had to unwind the windlass by 1 to 2 rotations to release the tightness to fasten it through the hook and thus decreased its effectiveness.

It is possible that tourniquet time to application, effectiveness, ease of learning, ease of use, durability, and pain could differ by factors other than scenario of application. Additional information in terms of age, sex, height and weight, and upper extremity strength would have allowed investigation into whether speed, effectiveness, and opinion of a tourniquet differed by these variables.

## CONCLUSION

When tested on a group of CF Med Techs, the C-A-T remained the CF field tourniquet of choice, based on the assessed criteria. It was the fastest and most effective tourniquet when tested in various scenarios. Although all 3 tourniquets had generally similar survey results, the C-A-T consistently scored higher and was ranked first by 95% of participants.

It is important that these results should not be extrapolated to a population that has never been exposed to previous tourniquet training. Although there is inherent bias in the approach of this study, it reflects the true situation and process required to determine if a new piece of equipment is superior to what is already considered the standard to a trained and equipped military. It is recommended that a similar study, using the newest version of the SOFTT-W, be repeated with participants who have never had any previous tourniquet training.

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