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| Question | |
| **Should one type of tourniquet compared with another type of tourniquet be used for adults and children with severe, life-threatening external bleeding?** | |
| **Population:** | Adults and children with severe, life-threatening external bleeding |
| **Intervention:** | Windlass tourniquets |
| **Comparison:** | Other design tourniquets |
| **Main outcomes:** | Death owing to bleeding, cessation of bleeding (restoration of hemostasis), and time to hemostasis, death from any cause, decrease in bleeding, and adverse effects (e.g. wound infection, limb loss, re-bleeding, pain related to an intervention). Where possible, the Evidence to Decision tables also include information regarding outcomes related to provider ability to use / ease of use / feasibility / satisfaction (for method of bleeding control) and predictors of use/response (for method of bleeding control). |
| **Setting:** | All studies performed in the out-of-hospital setting (direct evidence), as well as studies providing indirect evidence about the effects of interventions collected in combat (military) settings, simulations (i.e. human volunteers, human cadaver or other models excluding animal models), and studies performed in the hospital setting, that clinical content experts judged as performed in sufficiently similar conditions to still be informative. |
| **Perspective:** | Of the first aid provider and/or patient |
| **Background:** | Traumatic injury is a leading cause of morbidity and mortality and a major cause of death from traumatic injury is uncontrolled bleeding. Tourniquets and hemostatic dressings have the potentially to prevent morbidity and mortality from traumatic bleeding. Therefore, it is easy to see that first aid care is essential to help prevent injury related morbidity and mortality, as injured persons can exsanguinate from severe injuries in only a few minutes.  Current first aid recommendations for an individual with severe, life-threatening external bleeding includes applying direct pressure as standard therapy. Tourniquets and hemostatic dressings have been found to control bleeding effectively, therefore may be considered for use when standard measures are unable to control hemorrhage or in the situation where a first aid provider is unable to use standard first aid practices (for tourniquets) or for body areas where a tourniquet cannot be applied or is unable to control bleeding (for hemostatic dressings). There is no or limited data supporting the use of pressure points, elevation, or localized cold therapy. |
| **Conflict of interests:** | None identified |

# Assessment

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| Problem Is the problem a priority? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know | Traumatic injury is the leading cause of injury related morbidity and mortality throughout the world, resulting in millions of hospitalizations each year. The leading cause of preventable mortality in injured patients is uncontrolled hemorrhage {Jacobs 2014 67}. Hemorrhage is cited as the primary cause of death in 35% of traumatic mortalities and often contributes to death ultimately attributed to other causes {Kauvar 2006 S3)}. In addition, trauma related deaths disproportionality affects those in low- and middle-income countries where well established pre-hospital trauma systems may not exist {World Health Organization 2018}. | While direct manual pressure is the gold standard for hemorrhage control in life-threatening bleeding, the addition of a tourniquet could provide better hemorrhage control or enhance the effect of direct manual pressure. It may be easier for a first aid provider to access an improvised tourniquet therefore it is important to determine if there are certain types of tourniquets perform better. |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ○ Large ● Varies ○ Don't know | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | | **Certainty assessment** | | | | | | | **№ of patients** | | **Effect** | | **Certainty** | **Importance** | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **№ of studies** | **Study design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other considerations** | **windlass tourniquet** | **other tourniquets** | **Relative (95% CI)** | **Absolute (95% CI)** | | Cessation of bleeding - Simulation (assessed with: Doppler imaging, pulse palpation, simulated blood flow) | | | | | | | | | | | | | | 10 | observational studies | serious a | not serious | serious b | serious c | none | Six simulation studies in healthy volunteers where tourniquets were self-applied or applied by another person, and four simulation studies on mannequin models, together reporting 750 observations. The windlass tourniquets included the Combat Application Tourniquet (CAT), the Special Operations Forces Tactical Tourniquet (SOFTT) and a tactical mechanical tourniquet with a windlass mechanism. Other types of tourniquets included pneumatic, ratchet, silicone, stretch/wrap, one-handed (elastic), self-applied tourniquet system (cantilever), and block and tackle. In 7 studies, the proportion of participants (or observations) in which bleeding ceased was similar between windlass and other types of tourniquet {Beaven 2017 e1929; Gibson 2016 21; Gibson 2016 29; Guo 2011 151; O'Conor 2017 27; Peponis 2016 17; Wall 2013 578}. In one study, only 8.3% (applied by researcher) to 16.6% (self-applied) of applications were successful with windlass tourniquet, while 75% were successful with a pneumatic tourniquet (p<0.001).(Taylor 2011 591) In another study, using 18 iterations for several types of tourniquets, windlass tourniquets (CAT, SOFTT) were 100% effective, while other types of tourniquet had success rates ranging from 22% to 100% (Walters 2005 416). A final study showed a lower success rate (applied pressure at least 200mmHg) with CAT (57/78 [73.1%[) vs Israeli Silicone Tourniquet (71/78 [91.0%]; p=0.007) {Glick 2018 157)}. | | | | ⨁◯◯◯ VERY LOW | CRITICAL | | Time to hemostasis (simulation studies) (assessed with: seconds) | | | | | | | | | | | | | | 6 | observational studies | serious a | not serious | serious b | serious c | none | One simulation study in healthy volunteers {Beaven 2017 e1929} and five simulation studies in mannequin models {Bequette 2017 84; Gibson 2016 21; Gibson 2016 29; Glick 2018 157; O'Conor 2017 27}. In 3 studies, the difference in time to hemostasis ranged from 1s to 20s, but was not consistently greater or less with windlass tourniquet. Time to hemostasis ranged from 10s to 90s {Beaven 2017 e1929; Gibson 2016 21; Glick 2018 157; O'Conor 2017 27}. The greatest difference in one study was a 50s shorter time to hemostasis with windlass tourniquet compared to a ratchet design {Gibson 2016 29; }Bequette 2017 84 compared four different belt tourniquets: two windlass (Tourni-belt, Tourniquet Belt), one ratchet (ParaBelt) and one pulley system (Battle Buddy). Time to hemostasis was overall somewhat longer than in the other studies, ranging from 56 to 80 seconds. No difference was observed between the belts, except for a shorter time to hemostasis with ParaBelt compared to Tourniquet Belt (p=0.048). | | | | ⨁◯◯◯ VERY LOW | CRITICAL | |  | | | | | | | | | | | | | | | There is no clear evidence that one works better than the other. |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ○ Moderate ● Small ○ Trivial ○ Varies ○ Don't know | | **Certainty assessment** | | | | | | | **№ of patients** | | **Effect** | | **Certainty** | **Importance** | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **№ of studies** | **Study design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other considerations** | **windlass tourniquet** | **other tourniquets** | **Relative (95% CI)** | **Absolute (95% CI)** | | Complications / adverse events - Simulation | | | | | | | | | | | | | | 4 | observational studies | serious a | not serious | serious b | serious c | none | Four simulation studies with healthy volunteers. All studies showed no benefit in windlass tourniquets compared with other designs reporting only small differences in the proportion of participants experiencing pain or discomfort. Pain occurred in 0% to 5% of participants and typically was reported to be less than 5 on a scale of 1 (no pain) to 10 (worst pain) for all tourniquet types. {Beaven 2017 e1929; Peponis 2016 17; Taylor 2011 591; Walters 2005 416} | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | There was pain; however, differences in pain between designs was minimal.  There are also studies that looked at failure; however mostly due to application and not breakage. |
| Certainty of evidence What is the overall certainty of the evidence of effects? | | |
| Judgement | Research evidence | Additional considerations |
| ● Very low ○ Low ○ Moderate ○ High ○ No included studies | |  | | --- | | The certainty of the evidence across all outcomes was determined to be very low. Certainty downgrades were due to risk of bias, indirectness and imprecision. | |  |
| Values Is there important uncertainty about or variability in how much people value the main outcomes? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability ○ Possibly important uncertainty or variability ● Probably no important uncertainty or variability ○ No important uncertainty or variability | No research evidence. | Like other forms of hemostasis for control of severe, life-threatening bleeding, the outcomes of reduced mortality and control of bleeding are valued. The main goal is to have rapid, effective bleeding cessation.  There is no specific research evidence regarding the value of tourniquets specifically. |
| Balance of effects Does the balance between desirable and undesirable effects favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ● Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ○ Don't know | Six simulation studies {Beaven 2017 e1929; Guo 2011 151; Peponis 2016 17; Walters 2005 416; Taylor 2011 591; Wall 2013} in healthy volunteers where tourniquets were self-applied or applied by another person, and four simulation studies {Gibson 2016 21; Gibson 2016 29; Glick 2018 157; O'Conor 2017 27) on mannequin models, together reporting 750 observations were reviewed. The windlass tourniquets included the Combat Application Tourniquet (CAT), the Special Operations Forces Tactical Tourniquet (SOFTT) and a tactical mechanical tourniquet with a windlass mechanism. Other tourniquet designs included pneumatic, ratchet, silicone, stretch/wrap, one-handed (elastic), self-applied tourniquet system (cantilever), and block and tackle. In 7 studies (Beaven 2017 e1929; Gibson 2016 21; Gibson 2016 29; Guo 2011 151; O'Conor 2017 27; Peponis 2016 17; Wall 2013 578), the proportion of participants (or observations) in which bleeding ceased was similar between windlass and other types of tourniquet. In one study {Taylor 2011 591}, only 8.3% (applied by researcher) to 16.6% (self-applied) of applications were successful with a windlass tourniquet, while 75% were successful with a pneumatic tourniquet (p<0.001) In another study (Walters 2005),using 18 iterations for several types of tourniquets, windlass tourniquets (CAT, SOFTT) were 100% effective, while other types of tourniquet had success rates ranging from 22% to 100%. A final study {Glick 2018 157} showed a lower success rate (applied pressure at least 200mmHg) with CAT (57/78 [73.1%[) vs Israeli Silicone Tourniquet (71/78 [91.0%]; p=0.007).  One simulation study in healthy volunteers {Beaven 2017 e1929} and five simulation studies in mannequin models {Bequette 2017 84; Gibson 2016 21; Gibson 2016 29; Glick 2018 157; O'Conor 2017 27} were found to compare time to hemostasis. Time to hemostasis ranged from 10s to 90s {Beaven 2017 e1929; Gibson 2016 21; Glick 2018 157; O'Conor 2017 27} but was not consistently greater or less with windlass tourniquet. The greatest difference in one study {Gibson 2016 29} was a 50s shorter time to hemostasis with windlass tourniquet compared to a ratchet design. One study (Bequette 2017 84) compared four different belt tourniquets: two windlass (Tourni-belt, Tourniquet Belt), one ratchet (ParaBelt) and one pulley system (Battle Buddy). Time to hemostasis was overall somewhat longer than in the other studies, ranging from 56 to 80 seconds. No difference was observed between the belts, except for a shorter time to hemostasis with ParaBelt compared to Tourniquet Belt (p=0.048).  Four simulation studies {Beaven 2017 e1929; Peponis 2016 17; Taylor 2011 591; Walters 2005 416} with healthy volunteers were reviewed. All studies showed no benefit with use of windlass tourniquets compared with other designs, reporting only small differences in the proportion of participants experiencing pain or discomfort. Pain occurred in 0% to 5% of participants and typically was reported to be less than 5 on a scale of 1 (no pain) to 10 (worst pain) for all tourniquet types. |  |
| Resources required How large are the resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs ○ Moderate costs ● Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know | No research evidence identified.  We were able to review medical supply catalogs and sales websites. | At an individual level the cost of a single tourniquet to control life threatening bleeding is minimal and the benefits are high. To create a system so that every responder has the capability to control life threatening bleeding is high. The larger the system the higher the expense.  There would be a cost to purchase and stock devices as well as training to implement them. Training costs would include development of material, training aids, instructor training and first aid provider training.  Based on review of these sites, tourniquets and hemostatic dressings have a somewhat similar cost [Cost of tourniquet in Belgium: 37€ (CAT) or 39€ (SOFT).]  CAT approximately $50 USD  Tourniquet in Japan costs approximately 25 USD (approximately 1% of the cost of an AED). There are more than 500,000 AEDs in Japan. If we require the same number of tourniquets as AEDs, it will cost 12,500,000 USD. It seems reasonable in Japan.  Tourniquets range in price in different countries.  When comparing between types, there is minimal cost difference. |
| Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Very low ○ Low ○ Moderate ○ High ● No included studies | No research evidence identified. | Very little data is available to assess the individual and population cost of tourniquet implementation. Though costs are known (cost of these devices can be found online), we do not know the cost of implementation. |
| Cost effectiveness Does the cost-effectiveness of the intervention favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ● Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ○ No included studies | No research evidence identified. | The costs of being prepared for the unlikely event of an uncontrollable l bleed likely to be high from a system point of view but are also moderately high from an individual point of view.  In specific situations, such as military/combat settings in which 1) application of manual pressure or hemostatic dressings is not feasible while under fire; 2) loss of life of both injured soldier and rescuer soldier puts the rest of the unit at risk and 3) tourniquet cost may be less to the organization than for the general public, cost-effectiveness likely favors the intervention.  AED saves about 1,000 neurological favorable lives every year in Japan. If tourniquets can save 10 patients every year, Japan feels this would be cost-effective. |
| Equity What would be the impact on health equity? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced ○ Probably reduced ● Probably no impact ○ Probably increased ○ Increased ○ Varies ○ Don't know | No research evidence identified. | As these agents offer an expense above direct manual pressure alone, this may reduce health equity to rural areas that may be less likely to afford tourniquets but may benefit most due to prolonged transport times. In addition, on a systems level, some organizations may not be able to purchase these due to the cost.  As types are being compared, no major difference in equity between the intervention and comparison. |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know | [Wall PL](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wall%20PL%5BAuthor%5D&cauthor=true&cauthor_uid=25494426), [Welander JD](https://www.ncbi.nlm.nih.gov/pubmed/?term=Welander%20JD%5BAuthor%5D&cauthor=true&cauthor_uid=25494426), [Smith HL](https://www.ncbi.nlm.nih.gov/pubmed/?term=Smith%20HL%5BAuthor%5D&cauthor=true&cauthor_uid=25494426), [Buising CM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Buising%20CM%5BAuthor%5D&cauthor=true&cauthor_uid=25494426), [Sahr SM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Sahr%20SM%5BAuthor%5D&cauthor=true&cauthor_uid=25494426)**.** What do the people who transport trauma patients know about tourniquets? [J Trauma Acute Care Surg.](https://www.ncbi.nlm.nih.gov/pubmed/25494426) 2014 Nov;77(5):734-742.   * Survey respondents included 27 basic, 1 intermediate, and 75 paramedic emergency medical technicians; 1 registered nurse; 4 firefighters without medical certifications; 2 respondents not yet certified; and 1 respondent not listing certifications. * Twenty-five had used tourniquets: 5 in military and 22 in civilian settings. * Tourniquet knowledge was poor for all groupings (with or without tourniquet experience, military experience, all certifications, all years of experience): 91% did not understand that wider tourniquets require less pressure for arterial occlusion, 69% did not know that stopping venous flow without arterial is harmful, and 37% did not know the correct tourniquet locations for distal limb injuries. Of the 81 on a service and without military experience, 44 had received any tourniquet training; 14 of the 44 had commercial emergency tourniquet access, and 27 indicated their service had a tourniquet protocol. Of the 37 on a service with no tourniquet training, 5 had access to a commercial emergency tourniquet, and 5 indicated their service had a tourniquet protocol.   [Ross EM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ross%20EM%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Redman TT](https://www.ncbi.nlm.nih.gov/pubmed/?term=Redman%20TT%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Mapp JG](https://www.ncbi.nlm.nih.gov/pubmed/?term=Mapp%20JG%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Brown DJ](https://www.ncbi.nlm.nih.gov/pubmed/?term=Brown%20DJ%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Tanaka K](https://www.ncbi.nlm.nih.gov/pubmed/?term=Tanaka%20K%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Cooley CW](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cooley%20CW%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Kharod CU](https://www.ncbi.nlm.nih.gov/pubmed/?term=Kharod%20CU%5BAuthor%5D&cauthor=true&cauthor_uid=29455698), [Wampler DA](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wampler%20DA%5BAuthor%5D&cauthor=true&cauthor_uid=29455698). Stop the Bleed: The Effect of Hemorrhage Control Education on Laypersons' Willingness to Respond During a Traumatic Medical Emergency. [Prehosp Disaster Med.](https://www.ncbi.nlm.nih.gov/pubmed/29455698) 2018 Apr;33(2):127-132.   * Trainers used a pre-event questionnaire to assess participant’s knowledge and attitudes about tourniquets and responding to traumatic emergencies. Each training course included an individual evaluation of tourniquet placement, 20 minutes of didactic instruction on hemorrhage control techniques, and hands-on instruction with tourniquet application on both adult and child mannequins. The primary outcome was the willingness to use a tourniquet in response to a traumatic medical emergency. * When initially asked if they would use a tourniquet in real life, 64.2% (140/218) responded "Yes." Following training, 95.6% (194/203) of participants responded that they would use a tourniquet in real life. * When participants were asked about their comfort level with using a tourniquet in real life, there was a statistically significant improvement between their initial response and their response post training (2.5 versus 4.0, based on 5-point Likert scale; P<.001). * It was found that a short educational intervention can improve laypersons' self-efficacy and reported willingness to use a tourniquet in an emergency.   [Sidwell RA](https://www.ncbi.nlm.nih.gov/pubmed/?term=Sidwell%20RA%5BAuthor%5D&cauthor=true&cauthor_uid=29155270), [Spilman SK](https://www.ncbi.nlm.nih.gov/pubmed/?term=Spilman%20SK%5BAuthor%5D&cauthor=true&cauthor_uid=29155270), [Huntsman RS](https://www.ncbi.nlm.nih.gov/pubmed/?term=Huntsman%20RS%5BAuthor%5D&cauthor=true&cauthor_uid=29155270), [Pelaez CA](https://www.ncbi.nlm.nih.gov/pubmed/?term=Pelaez%20CA%5BAuthor%5D&cauthor=true&cauthor_uid=29155270). Efficient Hemorrhage Control Skills Training for Healthcare Employees. [J Am Coll Surg.](https://www.ncbi.nlm.nih.gov/pubmed/29155270) 2018 Feb;226(2):160-164.   * More than 1,000 individuals were trained, and there were survey data for 870 participants. More than 40% of participants worked in nonclinical roles and 29% had no first aid or medical training. After completing skills training, 98% of participants indicated that they would be likely to take action to assist a bleeding victim and that they could correctly apply direct pressure or a tourniquet to control severe bleeding. | Studies demonstrate that both lay and emergency medical services providers are willing to apply tourniquets.  The intervention may be more acceptable to stakeholders with specific requirements (e.g., military) for hands-free control of bleeding.  Many providers have no (or limited) experience with tourniquets.  Commercial tourniquets are widely used by emergency services in France including Red Cross and other voluntary organizations.  These changes to more widely accepted use are recent and work will be needed to overcome the historical bias associated with the use of tourniquets.  Acceptability may however vary by region. |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know | Heldenberg E, Aharony D, Wolf T, Vishne T. Evaluating new types of tourniquets by the Israeli Naval special warfare unit. Disaster Mil Med. 2015 1: 1.   * The CAT had the highest assessment score by the operators, followed by the SOFTT and IRT (4.6±0.6, 4.0±1.0, 2.1±1.0, respectively). Both arm as well as the self-application, were faster for CAT as compared to SOFTT (13 ± 4 sec and 21 ± 8 sec versus 18 ± 7 sec and 54 ± 69 sec, respectively). CAT and SOFTT thigh applications were much quicker (19 ± 7 sec and 24 ± 7 sec, respectively) as compared to the IRT, which on average took at least twice as long to place (53 ± 23 sec). The IRT thigh application failure rate was 38%, as compared to 22% and 23% for the CAT and SOFTT, respectively. SOFTT arm application failure rate was lower than the CAT application failure rate (6% and 10%, p = 0.266). CAT application failure rate was lower when self-application was used (SOFTT 20%, CAT 14%, p = 0.5). * No evidence demonstrating that wet tourniquets either prolonged application time or increased tourniquet application failure rate, at all anatomical sites, was found. Medics had no advantage as compared to the non-medic operators regarding tourniquet's application. Generally, non-medic operators placed the tourniquets faster, though medics were quicker in self-applying the SOFTT (37 ± 58 sec as opposed to 55 ± 69 sec, p = 0.236). Operator failure rates while applying arm CAT were higher as compared with the SOFTT application (12% versus 2%, p < 0.04). Failure rates of the improvised tourniquet application (35%) were higher as compared with both the CAT and SOFTT (23 and 21%, respectively), though without statistical significance. No difference was found in self-application failure rate (18%), of the latter two tourniquets. Medic failure rates of CAT and SOFTT arm application did not differ (8% and 10%, respectively, p = 1). Thigh CAT application was more effective than that of the IRT (21% and 40% failure, respectively, p = 0.019). Medics’ CAT self-application was more effective than SOFTT (11% versus 22% failure, respectively) but without statistical significance. * The participant's assessed of the tourniquets’ manipulation and storage parameters in a scale of 1-5 (1- the lowest score and 5 – the highest one). The CAT was assessed as the preferred device (a score of 4.6 ± 0.6), followed by the SOFTT (4.0 ± 1.0) and the IRT (2.1 ± 1.0) (p < 0.0001).   [King DR](https://www.ncbi.nlm.nih.gov/pubmed/?term=King%20DR%5BAuthor%5D&cauthor=true&cauthor_uid=23536455), [van der Wilden G](https://www.ncbi.nlm.nih.gov/pubmed/?term=van%20der%20Wilden%20G%5BAuthor%5D&cauthor=true&cauthor_uid=23536455), [Kragh JF Jr](https://www.ncbi.nlm.nih.gov/pubmed/?term=Kragh%20JF%20Jr%5BAuthor%5D&cauthor=true&cauthor_uid=23536455), [Blackbourne LH](https://www.ncbi.nlm.nih.gov/pubmed/?term=Blackbourne%20LH%5BAuthor%5D&cauthor=true&cauthor_uid=23536455). Forward assessment of 79 prehospital battlefield tourniquets used in the current war. [J Spec Oper Med.](https://www.ncbi.nlm.nih.gov/pubmed/23536455) 2012 Winter;12(4):33-8.   * Tourniquet applications (79) were performed by special operations combat medics (47, 59%), flight medics (17, 22%), combat medics (12, 15%), and general surgeons (3, 4%). Most tourniquets were Combat Application Tourniquets (71/79, 90%). With tourniquets in place upon arrival at the FST, most limbs (83%, 54/65) had palpable distal pulses present; 17% were pulseless (11/65). Of all tourniquets, the use was venous in 83% and arterial in 17%. In total, there were 14 arterial injuries, but only 5 had effective arterial tourniquets applied.  [Tien HC](https://www.ncbi.nlm.nih.gov/pubmed/?term=Tien%20HC%5BAuthor%5D&cauthor=true&cauthor_uid=18656043), [Jung V](https://www.ncbi.nlm.nih.gov/pubmed/?term=Jung%20V%5BAuthor%5D&cauthor=true&cauthor_uid=18656043), [Rizoli SB](https://www.ncbi.nlm.nih.gov/pubmed/?term=Rizoli%20SB%5BAuthor%5D&cauthor=true&cauthor_uid=18656043), [Acharya SV](https://www.ncbi.nlm.nih.gov/pubmed/?term=Acharya%20SV%5BAuthor%5D&cauthor=true&cauthor_uid=18656043), [MacDonald JC](https://www.ncbi.nlm.nih.gov/pubmed/?term=MacDonald%20JC%5BAuthor%5D&cauthor=true&cauthor_uid=18656043). An evaluation of tactical combat casualty care interventions in a combat environment. [J Am Coll Surg.](https://www.ncbi.nlm.nih.gov/pubmed/18656043) 2008 Aug;207(2):174-8.  * Six patients had eight tourniquets applied. Five tourniquets were applied to four patients appropriately and saved their lives. There was one case of misuse where a venous tourniquet was applied.   [Sidwell RA](https://www.ncbi.nlm.nih.gov/pubmed/?term=Sidwell%20RA%5BAuthor%5D&cauthor=true&cauthor_uid=29155270), [Spilman SK](https://www.ncbi.nlm.nih.gov/pubmed/?term=Spilman%20SK%5BAuthor%5D&cauthor=true&cauthor_uid=29155270), [Huntsman RS](https://www.ncbi.nlm.nih.gov/pubmed/?term=Huntsman%20RS%5BAuthor%5D&cauthor=true&cauthor_uid=29155270), [Pelaez CA](https://www.ncbi.nlm.nih.gov/pubmed/?term=Pelaez%20CA%5BAuthor%5D&cauthor=true&cauthor_uid=29155270). Efficient Hemorrhage Control Skills Training for Healthcare Employees. [J Am Coll Surg.](https://www.ncbi.nlm.nih.gov/pubmed/29155270) 2018 Feb;226(2):160-164.   * More than 1,000 individuals were trained, and there were survey data for 870 participants. More than 40% of participants worked in nonclinical roles and 29% had no first aid or medical training. After completing skills training, 98% of participants indicated that they would be likely to take action to assist a bleeding victim and that they could correctly apply direct pressure or a tourniquet to control severe bleeding.   [Ross EM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ross%20EM%5BAuthor%5D&cauthor=true&cauthor_uid=29239763), [Mapp JG](https://www.ncbi.nlm.nih.gov/pubmed/?term=Mapp%20JG%5BAuthor%5D&cauthor=true&cauthor_uid=29239763), [Redman TT](https://www.ncbi.nlm.nih.gov/pubmed/?term=Redman%20TT%5BAuthor%5D&cauthor=true&cauthor_uid=29239763), [Brown DJ](https://www.ncbi.nlm.nih.gov/pubmed/?term=Brown%20DJ%5BAuthor%5D&cauthor=true&cauthor_uid=29239763), [Kharod CU](https://www.ncbi.nlm.nih.gov/pubmed/?term=Kharod%20CU%5BAuthor%5D&cauthor=true&cauthor_uid=29239763), [Wampler DA](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wampler%20DA%5BAuthor%5D&cauthor=true&cauthor_uid=29239763). The Tourniquet Gap: A Pilot Study of the Intuitive Placement of Three Tourniquet Types by Laypersons. [J Emerg Med.](https://www.ncbi.nlm.nih.gov/pubmed/29239763) 2018 Mar;54(3):307-314.   * Novice tourniquet users were randomized to apply one of three commercially available tourniquets (Combat Action Tourniquet [CAT; North American Rescue, LLC, Greer, SC], Ratcheting Medical Tourniquet [RMT; m2 Inc., Winooski, VT], or Stretch Wrap and Tuck Tourniquet [SWAT-T; TEMS Solutions, LLC, Salida, CO]) in a controlled setting. Individuals with formal medical certification, prior military service, or prior training with tourniquets were excluded. The primary outcome of this study was successful tourniquet placement. * Of 236 possible participants, 198 met the eligibility criteria. Demographics were similar across groups. The rates of successful tourniquet application for the CAT, RMT, and SWAT-T were 16.9%, 23.4%, and 10.6%, respectively (p = 0.149). The most common causes of application failure were: inadequate tightness (74.1%), improper placement technique (44.4%), and incorrect positioning (16.7%). | Tourniquets have been used in the emergency medical services and lay provider first aid setting however, the data regarding implementation of these is limited. There are legal and prescribing barriers in some countries such as Belgium and Australia. However, there is the consideration that if first aid guidelines recommend tourniquets this may help overcome those barriers. Training issues must be considered for either agent.  In some countries, such as Australia, hemostatic dressings are only available through a prescription, making access potentially difficult.  Commercial tourniquets are widely used by emergency services in France including Red Cross and other voluntary organizations.  Feasibility may however vary by region. |

# Summary of judgements

|  | **Judgement** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Problem** | No | Probably no | Probably yes | **Yes** |  | Varies | Don't know |
| **Desirable Effects** | Trivial | Small | Moderate | Large |  | **Varies** | Don't know |
| **Undesirable Effects** | Large | Moderate | **Small** | Trivial |  | Varies | Don't know |
| **Certainty of evidence** | **Very low** | Low | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | Possibly important uncertainty or variability | **Probably no important uncertainty or variability** | No important uncertainty or variability |  |  |  |
| **Balance of effects** | Favors the comparison | Probably favors the comparison | **Does not favor either the intervention or the comparison** | Probably favors the intervention | Favors the intervention | Varies | Don't know |
| **Resources required** | Large costs | Moderate costs | **Negligible costs and savings** | Moderate savings | Large savings | Varies | Don't know |
| **Certainty of evidence of required resources** | Very low | Low | Moderate | High |  |  | **No included studies** |
| **Cost effectiveness** | Favors the comparison | Probably favors the comparison | **Does not favor either the intervention or the comparison** | Probably favors the intervention | Favors the intervention | Varies | No included studies |
| **Equity** | Reduced | Probably reduced | **Probably no impact** | Probably increased | Increased | Varies | Don't know |
| **Acceptability** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |
| **Feasibility** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |

# Type of recommendation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | Conditional recommendation for the intervention | Strong recommendation for the intervention |
| ○ | ○ | X | ○ | ○ |

# Conclusions

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| Recommendation |
| For the treatment of severe, life-threatening external bleeding by first aid providers, we are unable to recommend any one particular design of tourniquet compared with another. |
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| Justification |
| * Due to very limited data and very low confidence in effect estimates, the Task Force is unable to recommend one tourniquet design, such as windlass, compared with another design, such as ratcheting or elastic tourniquet designs. * Simulation data regarding the use of a windless tourniquet in comparison with other types of tourniquets does not appear to show a clear benefit in one type of tourniquet compared with another. However, the majority of the military and civilian studies on tourniquets use windless tourniquets, and therefore, there is the most robust data regarding windlass tourniquets for human use. In making this recommendation the Task Force believes that many factors, including design and training, are involved in effective tourniquet use and that more comparative studies are needed to determine what type of tourniquet is the most effective and safe for civilian use. |

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| Subgroup considerations |
| N/A |

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| --- |
| Implementation considerations |
| Training materials would need to be developed and be flexible from country to country (or region to region). |

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| --- |
| Monitoring and evaluation |
| Groups who implement the device should track use and success of use (and adverse events) |

|  |
| --- |
| Research priorities |
| Studies comparing the effectiveness of various types of tourniquets in the first aid setting and if the devices can be used appropriately by first aid providers. It is also important to determine if first aid providers are able to recognize wounds that would be amenable to tourniquets. |

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