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| Question | |
| **Should a tourniquet compared with direct pressure be used for adults and children with severe, life-threatening external bleeding?** | |
| **Population:** | Adults and children with severe, life-threatening external bleeding |
| **Intervention:** | Tourniquets |
| **Comparison:** | Direct manual pressure or direct pressure to the wound with a compression dressing, compression bandage, or compression device |
| **Main outcomes:** | Death owing to bleeding, cessation of bleeding (restoration of hemostasis), and time to hemostasis, death from any cause, decrease in bleeding, need for transfusion, rebleeding, hospital admission, length of hospital stay, length of ICU stay, 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 or hemostatic dressing could provide better hemorrhage control or enhance the effect of direct manual pressure. |
| 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** | **a tourniquet** | **direct pressure** | **Relative (95% CI)** | **Absolute (95% CI)** | | Mortality due to bleeding – Civilian | | | | | | | | | | | | | | 4 1,2,3,4 | observational studies | serious b | serious c | not serious | serious d | none | Four cohort studies in the pre-hospital civilian setting with a total of 527 patients. For tourniquet and no tourniquet groups, respectively, {King 2015 594 }reported no mortality due to bleeding in both groups (0/27 vs 0/2 [unadjusted RR=0.10, 95% CI: 0.00-4.49; p=1.0]), Ode et al. {Ode 2015 586} observed only one death due to bleeding, in the tourniquet group (1/24 vs 0/32 [unadjusted RR=3.96, 95% CI: 0.17-93.17; p=0.43]), and Passos et al. {Passos 2014 573} observed only deaths due to bleeding in the group without a tourniquet (0/4 vs 6/186 [unadjusted RR=2.88, 95% CI: 0.19-44.37; p=1.0). The fourth cohort study {Scerbo 2017 712} reported a 3% (among 252 patients) versus 14% (among 29 patients; p=0.01) rate of death from hemorrhage shock when tourniquets were placed in the pre-hospital setting compared with the hospital setting, respectively. This resulted in multivariable analysis in a 4.5-fold increased risk of death from hemorrhagic shock if tourniquet placement was delayed until arrival at the hospital (OR=4.5, 95% CI: 1.23-16.4; p=0.02). | | | | ⨁◯◯◯ VERY LOW | CRITICAL | | Cessation of bleeding - Civilian | | | | | | | | | | | | | | 5 5,6,7,8,9,g | observational studies | serious h | not serious | not serious | not serious i | none | Among five case series with a total of 434 patients, the median rate of bleeding cessation with a tourniquet was 98%, and ranged from 89% to 100%. | | | | ⨁◯◯◯ VERY LOW | CRITICAL | | 5. Zietlow, John M., Zietlow, Scott P., Morris, David S., Berns, Kathleen S., Jenkins, Donald H.. Prehospital Use of Hemostatic Bandages and Tourniquets:Translation From Military Experience to Implementation in Civilian Trauma Care. Journal of special operations medicine : a peer reviewed journal for SOF medical professionals; 2015.  6. Schroll, Rebecca, Smith, Alison, McSwain, Norman E. Jr, Myers, John, Rocchi, Kristin, Inaba, Kenji, Siboni, Stefano, Vercruysse, Gary A., Ibrahim-Zada, Irada, Sperry, Jason L., Martin-Gill, Christian, Cannon, Jeremy W., Holland, Seth R., Schreiber, Martin A., Lape, Diane, Eastman, Alexander L., Stebbins, Cari S., Ferrada, Paula, Han, Jinfeng, Meade, Peter, Duchesne, Juan C.. A multi-institutional analysis of prehospital tourniquet use. The journal of trauma and acute care surgery; 2015.  7. Kue, Ricky C., Temin, Elizabeth S., Weiner, Scott G., Gates, Jonathan, Coleman, Melissa H., Fisher, Jonathan, Dyer, Sophia. Tourniquet Use in a Civilian Emergency Medical Services Setting: A Descriptive Analysis of the Boston EMS Experience. Prehospitalemergency care : official journal of the National Association of EMS Physicians and the National Association of State EMS Directors; 2015.  8. Leonard, Jennifer, Zietlow, John, Morris, David, Berns, Kathleen, Eyer, Steven, Martinson, Kurt, Jenkins, Donald, Zietlow, Scott. A multi-institutional study of hemostatic gauze and tourniquets in rural civilian trauma. The journal of trauma and acute care surgery; 2016.  9. Callaway, David W., Robertson, Joshua, Sztajnkrycer, Matthew D.. Law enforcement-applied tourniquets: a case series of life-saving interventions. Prehospital emergency care : official journal of the National Association of EMS Physicians and the National Association of State EMS Directors; 2015.  Note: It is likely that 2 series of cases (Leonard 2016 and Zietlow 2015) described the same or overlapping cohort of patients | | | | | | | | | | | | | | Cessation of bleeding - Military | | | | | | | | | | | | | | 2 | observational studies | serious b | not serious | not serious j | serious | none | One cohort study with a total of 70 patients showed a higher rate of absence of bleeding on arrival with tourniquet (83.3% vs 60.7%; p=0.033){Beekley 2008 S28}. The second cohort study showed bleeding cessation in 2/2 patients with tourniquet and 4/4 patients with injuries that were amenable to tourniquet but did not receive one {Mucciarone 2006 687} | | | | ⨁◯◯◯ VERY LOW | CRITICAL | | Cessation of bleeding - Military | | | | | | | | | | | | | | 3 12,13,14,15 | observational studies | serious h | not serious | not serious | serious k | none | Three cases series in the pre-hospital military setting that reported various units of analysis (patients, limbs, tourniquets). In King et al. {King 2012 33} 5/14 (35.7%) patients had no palpable pulse distal to the tourniquet; in Kragh 2008 and 2009, 270/309 (87.3%) limbs stopped bleeding; in Lakstein 2003, 107/110 (97.3%) tourniquet applications did not have ongoing bleeding at arrival to hospital. | | | | ⨁◯◯◯ VERY LOW | CRITICAL | | 12. Lakstein, Dror, Blumenfeld, Amir, Sokolov, Tali, Lin, Guy, Bssorai, Roni, Lynn, Mauricio, Ben-Abraham, Ron. Tourniquets for hemorrhage control on the battlefield: a 4-year accumulated experience. The Journal of trauma; 2003.  13. Kragh, John F. Jr, Walters, Thomas J., Baer, David G., Fox, Charles J., Wade,Charles E., Salinas, Jose, Holcomb, John B.. Practical use of emergency tourniquets to stop bleeding in major limb trauma. The Journal of trauma; 2008.  14. Kragh, John F. Jr, Walters, Thomas J., Baer, David G., Fox, Charles J., Wade, Charles E., Salinas,Jose, Holcomb, John B.. Survival with emergency tourniquet use to stop bleeding in major limb trauma. Annals of surgery; 2009.  15. King, David R., Wilden, Gwendolyn van der, Kragh, John F. Jr, Blackbourne, Lorne H.. Forward assessment of 79 prehospital battlefield tourniquets used in the current war. Journal of special operations medicine: a peer reviewed journal for SOF medical professionals; 2012. Winter;12(4):33-8. | | | | | | | | | | | | | | Time to hemostasis - not reported | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | CRITICAL | | Mortality due to all causes - Civilian | | | | | | | | | | | | | | 6 1,2,3,4,16,17 | observational studies | serious b | serious l | not serious | serious m | none | Six cohort studies with a total of 1,811 civilian patients. Among five unadjusted analyses, King {King 2015 594 } reported 0/27 (0.0%) vs 0/2 (0.0%; unadjusted RR=0.11, 95% CI: 0.00-4.49; p=1.0); Ode {Ode 2015 586} reported 4/24 (16.7%) vs 1/32 (3.1%; unadjusted RR=5.33, 95% CI: 0.64-44.72; p=0.15); Passos {Passos 2014 573} reported 0/4 (0.0%) vs 6/186 (3.2%; unadjusted RR=2.88, 95% CI: 0.19-44.37; p=1.0); Scerbo et al. {Scerbo 2017 712} reported 18/277 (6.5%) vs 4/29 (13.8%; unadjusted RR=0.47, 95% CI: 0.17-1.30; p=0.25); Smith 2018 reported 9/127 (7.1%) vs 10/77 (13.0%; unadjusted RR=0.55, 95% CI: 0.23-1.28; p=0.16). The sixth cohort study {Texeira 2018 769), with 1,026 patients total, reported a higher risk for all-cause mortality without tourniquet compared with tourniquet (5.2 vs 3.9%; univariable OR = 1.36, 95% CI: 0.60-1.65; p=0.452) which was significant in multivariable analysis (adjusted OR = 5.86, 95% CI: 1.41-24.47; p=0.015). | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Mortality due to all causes - Civilian | | | | | | | | | | | | | | 7 6,7,8,9,18,19,20 | observational studies | serious h | serious o | not serious | not serious | none | Seven case series with a total of 2,524 patients showed that the median all-cause mortality with a tourniquet was 7% and ranged from 0% to 10%. | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | 6. Schroll, Rebecca, Smith, Alison, McSwain, Norman E. Jr, Myers, John, Rocchi, Kristin, Inaba, Kenji, Siboni, Stefano, Vercruysse, Gary A., Ibrahim-Zada, Irada, Sperry, Jason L., Martin-Gill, Christian, Cannon, Jeremy W., Holland, Seth R., Schreiber, Martin A., Lape, Diane, Eastman, Alexander L., Stebbins, Cari S., Ferrada, Paula, Han, Jinfeng, Meade, Peter, Duchesne, Juan C.. A multi-institutional analysis of prehospital tourniquet use. The journal of trauma and acute care surgery; 2015.  7. Kue, Ricky C., Temin, Elizabeth S., Weiner, Scott G., Gates, Jonathan, Coleman, Melissa H., Fisher, Jonathan, Dyer, Sophia. Tourniquet Use in a Civilian Emergency Medical Services Setting: A Descriptive Analysis of the Boston EMS Experience. Prehospital emergency care: official journal of the National Association of EMS Physicians and the National Association of State EMS Directors; 2015.  8. Leonard, Jennifer, Zietlow, John, Morris, David, Berns, Kathleen, Eyer, Steven, Martinson, Kurt, Jenkins, Donald, Zietlow, Scott. A multi-institutional study of hemostatic gauze and tourniquets in rural civilian trauma. The journal of trauma and acute care surgery; 2016.  9. Callaway, David W., Robertson, Joshua, Sztajnkrycer, Matthew D. Law enforcement-applied tourniquets: a case series of life-saving interventions. Prehospital emergency care : official journal of the National Association of EMS Physicians and the National Association of State EMS Directors; 2015.  18. Scerbo, Michelle H., Mumm, Jacob P., Gates, Keith, Love, Joseph D., Wade, Charles E., Holcomb, John B., Cotton, Bryan A.. Safety and Appropriateness of Tourniquets in 105 Civilians. Prehospital emergency care: official journal of the National Association of EMS Physicians and the National Association of State EMS Directors; 2016.  19. Sayed, Mazen J. El, Tamim, Hani, Mailhac, Aurelie, Mann, N. Clay. Trends and Predictors of Limb Tourniquet Use by Civilian Emergency Medical Services in the United States. 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Beekley et al.{Beekley 2008 S28} reported 3/67 (4.5%) vs 4/98 (4.1%; unadjusted RR=1.10, 95% CI: 0.25-4.74; p=1.0); Gerheardt et al.{Gerhardt 2011 S109} reported 2/8 (25.0%) vs 2/9 (22.2%; unadjusted RR=1.13, 95% CI: 0.20-6.24; p=1.0); Kragh et al.{Kragh 2011 590} reported 26/228 (11.4%) vs 8/38 (21.1%; unadjusted RR=0.54, 95% CI: 0.27-1.11; p=0.09); Kragh et al.{Kragh 2015a 290} reported 88/720 (12.2%) vs 79/693 (11.4%; unadjusted RR=1.07, 95% CI: 0.81-1.43; p=0.63); Kragh et al.{Kragh 2015b 184} reported 102/1272 (8.0%) vs 112/3025 (3.7%; unadjusted RR=2.17, 95% CI: 1.67-2.81; p<0.001); Mucciarone et al. {Mucciarone 2006 687} reported 0/2 vs 0/3, for tourniquet vs no tourniquet respectively. | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Mortality due to all causes - Military | | | | | | | | | | | | | | 8 13,14,15,22,25,26,27,28,29,30,31 | observational studies | serious h | serious q | not serious | not serious | none | Eight case series with a total of 1,004 patients showed that the median all-cause mortality with a tourniquet was 10.7% and ranged from 0% to 13.4%. | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | 13. Kragh, John F. Jr, Walters, Thomas J., Baer, David G., Fox, Charles J., Wade, Charles E., Salinas, Jose, Holcomb, John B. Practical use of emergency tourniquets to stop bleeding in major limb trauma. The Journal of trauma; 2008.  14. Kragh, John F. Jr, Walters, Thomas J., Baer, David G., Fox, Charles J., Wade, Charles E., Salinas,Jose, Holcomb, John B.. Survival with emergency tourniquet use to stop bleeding in major limb trauma. Annals of surgery; 2009.  15. King, David R., Wilden, Gwendolyn van der, Kragh, John F. Jr, Blackbourne, Lorne H. Forward assessment of 79 prehospital battlefield tourniquets used in the current war. Journal of special operations medicine: a peer reviewed journal for SOF medical professionals; 2012.  22. Kragh, John F. Jr, Littrel, Michelle L., Jones, John A., Walters, Thomas J., Baer, David G., Wade, Charles E., Holcomb, John B. Battle casualty survival with emergency tourniquet use to stop limb bleeding. The Journal of emergency medicine; 2011  25. 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Trauma (United Kingdom); 2016 | | | | | | | | | | | | | | Decrease in bleeding - Military | | | | | | | | | | | | | | 1 | observational studies | serious h | not serious | not serious | serious s | none | In one case series with 3 time periods, 13/651 (2.0%) limbs in the first two time periods had paradoxical bleeding (tourniquet use led to increased bleeding{Kragh 2011 590}, and in the 3rd time period 262/277 (94.5%) limbs bled less after tourniquet application. {Kragh 2013 873) | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Rebleeding - Civilian | | | | | | | | | | | | | | 1  {Scerbo 2017 712} | observational studies | serious h | not serious | not serious | serious t | none | 3/252 (1.2%) | - | - | - | ⨁◯◯◯ VERY LOW | IMPORTANT | | Rebleeding - Military | | | | | | | | | | | | | | 1  {Beekley 2008 S28} | observational studies | serious h | not serious | not serious | serious u | none | 6/42 (14.3%) | - | - | - | ⨁◯◯◯ VERY LOW | IMPORTANT | | |  |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ● Moderate ○ Small ○ Trivial ○ Varies ○ Don't know | |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Limb loss (amputation) - Civilian | | | | | | | | | | | | | | 5 | observational studies | serious b | not serious | not serious | not serious | none | Three cohort studies showed that the risk of amputation ranged from 23% to 50% among those with a tourniquet and from 24% to 34% in those without a tourniquet. Passos et al {Passos 2014 573} reported 2/4 (50%) vs 61/186 (32.8%; unadjusted RR=1.52, 95% CI: 0.56-4.15; p=0.60). Romanoff et al. {Romanoff 1977 485} reported 5/14 (35.7%) vs 10/42 (23.8%; unadjusted RR=1.50, 95% CI: 0.62-3.64; p=0.37). Scerbo et al. {Scerbo 2017 712} reported 58/252 (23.0%) vs 10/29 (34.5%; unadjusted RR=0.67, 95% CI: 0.39-1.16; p=0.15). According to the authors no loss of a limb was attributed to the use of a tourniquet {Passos 2014 573; Romanoff 1977 485; Scerbo 2017 712}. A matched cohort study with 204 patients reported a lower rate of secondary amputation with tourniquet vs no tourniquet (1/127 [0.8%] vs 7/77 [9.1%]; RR=0.09, 95% CI: 0.01-0.69; p=0.005){Smith 2018 43} A fifth cohort study with 1,026 patients reported a comparable rate of delayed amputation in multivariable analysis (2/181 [1.1%] vs 9/845 [1.1%]; adjusted OR = 1.82, 95% CI: 0.36-9.99; p=0.473){Teixeira 2018 769}. | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Limb loss (amputation) - Civilian | | | | | | | | | | | | | | 5 | observational studies | serious h | serious v | not serious | not serious | none | Among the five cases series {Schroll 2015 10, Leonard 2016 441; Callaway 215 320, Scerbo 2017 712, Romanoff 1977 485} including a total of 454 patients in whom a tourniquet was used, the median amputation rate was 17.2%, and ranged from 0% to 28.6%. Authors either reported that none was attributed to the tourniquet use or did not comment of the cause of limb loss. In one series of cases the authors reported one limb loss likely to be caused by the use of tourniquet{Inaba 2015 232} | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Limb loss (amputation) - Military | | | | | | | | | | | | | | 1  {Beekley 2008 S28} | observational studies | serious | not serious | not serious | very serious w | none | 4/67 (6.0%) | 9/98 (9.2%) | **RR 0.65** (0.21 to 2.02) n | **32 fewer per 1,000** (from 73 fewer to 94 more) | ⨁◯◯◯ VERY LOW | IMPORTANT | | Complications / adverse events - Civilian | | | | | | | | | | | | | | 3 2,16,17 | observational studies | serious b | not serious | not serious | serious x | none | Complications were reported in three cohort studies with a total of 1,420 patients. One cohort study with 190 patients {Passos 2014 573} showed a lower rate of compartment syndrome with tourniquet compared with no tourniquet (0/4 [0.0%] vs 29/186 [15.6%]; unadjusted RR=0.63, 95% CI: 0.04-8.98; p=1.0). A matched cohort study with 204 patients {Smith 2019 43} showed a comparable rate of compartment syndrome (9/127 [7.1%] vs 5/77 [6.5%]; unadjusted RR=1.09, 95% CI: 0.38-3.14; p=0.87) and nerve palsy (8/127 [6.3%] vs 2/77 [2.6%]; unadjusted RR=2.43, 95% CI: 0.53-11.13; p=0.33), but a lower rate of fasciotomy (16/127 [12.6%] vs 27/77 [35.1%]; unadjusted RR=0.36, 95% CI: 0.21-0.62; p<0.001) with tourniquet compared with no tourniquet, respectively. A cohort study with 1,026 patients {Teixeira 2018 769) reported a lower rate of thromboembolic complications without tourniquet compared with tourniquet (13/181 [3.4%] vs 29/845 [7.2%]; adjusted OR = 0.44, 95% CI: 0.21-0.95; p=0.039). n | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Complications / adverse events - Civilian | | | | | | | | | | | | | | 3 6,7,8 | observational studies | serious h | serious p | not serious | serious y | none | Complications were reported in three case series with a total of 356 patients. Compartment syndrome was reported in 17/197 (8.6%) of patients receiving a tourniquet in Schroll et al.{Schroll 2015 10}. The rate of nerve palsy was 1/95 (1.1%) in Kue et al. {Kue 2015 399}, 0/61 (0%) in Leonard et al.{Leonard 2016 441}, and 12/197 (6.1%) in Schroll et al. {Schroll 2015 10}. Ischemia/reperfusion injury was reported in 1/95 (1.1%) in Kue et al. {Kue 2015 399} and in 7/197 (3.6%) in Schroll et al. {Schroll 2015 10}. | | | | ⨁◯◯◯ VERY LOW | IMPORTANT | | Compartment syndromes, palsies and limb loss were reported. A number of the instances of limb loss cannot necessarily be attributed to the tourniquet. |
| 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 with a few exceptions. Certainty downgrades were typically due to risk of bias, indirectness and/or 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 identified. | 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 or direct pressure 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 | Four cohort studies in the pre-hospital civilian setting with a total of 527 patients (King 2015 594, Ode 2015 586, Passos 2014 573, Scerbo 2017 1165) report variable results but appear to show benefit for the use of tourniquets compared with the use of direct pressure alone. These studies report variable results but suggest a reduction in mortality due to bleeding with the use of tourniquets compared with the use of direct pressure alone. The mortality rate with tourniquet use ranged from 0 to 4%, whereas mortality with direct pressure alone ranged from 0 to 14%.  Six cohort studies (King 2015 594, Ode 2015 586, Passos 2014 573, Scerbo 2017 1165, Smith 2019 43, Texeira 2018 769) with a total of 1,811 civilian patients to evaluate all-cause mortality. Due to heterogeneity these studies were unable to be combined for meta-analysis. The overall quality of evidence was rated as very low primarily due to serious risk of bias, inconsistency and imprecision. Five of the six unadjusted analyses failed to demonstrate a statically significant difference in mortality between those with a tourniquet placed compared with those receiving direct pressure alone (King 2015 594, Ode 2015 586, Passos 2014 573, Scerbo 2017 1165, Smith 2019 43). A sixth large cohort study (Texeira 2018 769), with 1,026 total participants reported a higher risk for all-cause mortality without use of a tourniquet compared with use of a tourniquet (5.2% compared with 3.9%; univariable OR, 1.36; 95% CI, 0.60-1.65; p = 0.452) which was significant in a multivariable analysis (adjusted OR, 5.86; 95% CI, 1.41-24.47; p = 0.015).  Five cohort studies (Passos 2014 573, Romanoff 1977 485, Scerbo 2017 1165, Smith 2018 43, Teixeira 2018 769) in the prehospital civilian setting with a total of 1686 patients were found that reported the complication of amputation. Due to heterogeneity, these studies could not be combined for meta-analysis, but all reported similar amputation rates with the use of tourniquets compared with use of direct pressure.  One additional cohort study (Beekley 2008 S28) in the prehospital military setting with 165 participants was found to evaluate amputation rates. This study showed no difference in the amputation rates for those who had tourniquets applied (4/67 (6.0%)) compared with use of direct pressure (9/98 (9.2%); RR, 0.65; 95% CI, 0.21-2.20; ARR, 32 fewer per 1,000 participants [95% CI, 73 fewer to 94 more]). | There are reported adverse events possibly associated with tourniquets. The cessation of severe, life-threatening bleeding is the critical outcome and must be taken into consideration when determining risk/benefit.  For the specific circumstance of an injury with life-threatening bleeding in a location that is amenable to use of a tourniquet, the desirable effects (mortality) compared with the undesirable effects probably favor use of the intervention. |
| 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 was identified.  We were able to review medical supply catalogs and sales websites. | 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.  Cost of tourniquet in Belgium: 37€ (CAT) or 39€ (SOFT). In comparison passive dressings (without hemostatic agents): 15€ Simple hemostatic dressings in first aid (used by Belgian Red Cross): +/-1€ New Israeli bandages: 10€.]  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. |
| 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 was identified. | Very little data is available to assess the individual and population cost of tourniquet and/or hemostatic dressing implementation. The cost of these devices and dressings can be found online. |
| 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 was identified. | The costs of being prepared for the unlikely event of an uncontrollable junctional 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 was identified. | We are unaware of any data on the cost effectiveness or impact on health equity but for lower socioeconomic individuals of resource poor systems it is felt that recommending tourniquets may decease health equity as these populations may be less likely to be able to afford the product. However, while these areas may be less likely to afford tourniquets they may benefit more in these areas due to potentially prolonged transport times. |
| 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. Emergency medical providers are willing to apply hemostatic dressings, but little data is currently available regarding hemostatic dressings.  The intervention may be more acceptable to stakeholders with specific requirements (e.g., military) for hands-free control of bleeding.  Some hemostatic dressings have obtained FDA approval, others have not.  Many providers have no (or limited) experience with tourniquets of hemostatic dressings.  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%). | Both tourniquets and hemostatic dressings have been used in the emergency medical services and lay provider first aid setting however, the data regarding implementation of either of these agents is limited. There are legal and prescribing barriers in some countries as hemostatic dressings are considered medications in countries such as Belgium and Australia. However, there is the consideration that if first aid guidelines recommend either hemostatic dressing or 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 |
| We suggest that first aid providers use tourniquets in comparison with direct pressure for severe, life threatening external bleeding that is amenable to the application of a tourniquet (weak recommendation, based on very low certainty of evidence). |
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| Justification |
| * The Task Force recognizes that pressure stops bleeding. Tourniquets represent a way of applying pressure and evidence suggests that tourniquets, when applied appropriately, stop bleeding nearly 100% of the time. * Not every area of the body is amenable to the use of a tourniquet. In general, studies included application of tourniquets to the limbs but excluding the junctional regions. * The Task Force was strongly influenced by in one observational study (Scerbo 2017 54) which demonstrated a greater risk of death from hemorrhagic shock (14% compared with 3.0%, p=0.01) when tourniquet placement was delayed until arrival at hospital compared with when they were placed in the field. We also place value in a second observational study (Texeira 2018 769) that demonstrated a higher risk for all-cause mortality without the use of a tourniquet when compared with the use of a tourniquet (5.2 compared with 3.9%; adjusted OR=5.86, 95% CI: 1.41-24.47; p=0.015). * We recognize that the use of tourniquets provides an added material and training expense that may increase healthcare disparity in some cases. We also recognize that implementation of tourniquet use on a small or large scale may not be feasible in some areas. * We recognize that a tourniquet may not always be available for treatment initially. However, if a tourniquet is made available and is used, it may free resources to attend to other life-threatening injuries. |

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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) |

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| 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 and how much education would be needed in order to deploy tourniquets on a mass scale. |

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