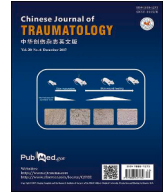




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LST-A novel junctional tourniquet: A study of feasibility and effectiveness

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ABSTRACT

Uncontrolled hemorrhage is a leading cause of mortality in trauma. It is considered the most significant preventable cause of death in trauma patients. Junctional hemorrhages are responsible for approximately 20% of this possibly preventable mortality. At this time, the options for controlling such hemorrhages are either by manual pressure points or the use of junctional tourniquets, which, although they have been proven to be effective, are cumbersome and not readily available to the medical team in the field. The objective of this study was to evaluate the effectiveness and feasibility of a new junctional tourniquet (Life Saving Tourniquet, T-W-Medical Ltd.) that is simpler to use and can perform both as a regular tourniquet and a junctional one.

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1. Introduction

Effective management of hemorrhage is a keystone element in trauma treatment.¹ Hemorrhage has been long recognized as the most significant preventable cause of death, and its treatment is a cornerstone in all major trauma guidelines (Advanced Trauma Life Support, Pre Hospital Trauma Life Support, and Tactical Combat Casualty Care).^{2–4}

Junctional hemorrhages (e.g., axillary and femoral) are considered to cause up to 20% of fatalities in civilian and military settings.^{1,5} Control of junctional hemorrhage can be achieved by 2 possible means-manual pressure points using the hand to apply pressure above major blood vessels⁶ or junctional tourniquets (JT) which are devices able to apply localized pressure. These devices have been shown in several studies and a meta-analysis to be effective. However, they are not very durable and their use in the field is yet to be established.^{7–10} The existing JT is based either on a tourniquet that has an inflatable balloon (e.g. Abdominal Aortic Junctional Tourniquet, SAM[®] tourniquet) or a screw-driven pressure point (e.g. Junctional emergency treatment tool). These devices are larger than regular tourniquets and are largely cumbersome for field use. An effective JT should offer both

effectiveness and simplicity so it can be applied quickly and by all those treating a bleeding injury.

In this study, we described a novel JT that uses a simple method for junctional hemorrhages effectively. The Life Saving Tourniquet (LST, T-W-Medical Ltd.) uses a cone shaped part that attaches to a newly designed tourniquet offering both the usual tourniquet abilities and with a simple addition of the cone becomes a JT that is easy to use on both supraclavicular and femoral pressure points.

2. Methods

This was a feasibility study performed on a cohort of healthy volunteers from 1/9/2024 through 15/10/2024. The study was approved by the Israeli Ministry of Health's review board (202434744).

2.1. The LST device

As shown in Fig. 1, the LST has a base tourniquet with a longer strap than the ones available today. It has a central bridge with a tightening rod. The base can connect to a cone with a silicone head that will perform the localized pressure. The application is demonstrated on the LST website.¹¹

2.2. Study protocol

After signing a written consent, healthy volunteers used the LST on a supraclavicular site and a femoral site. Before the application of the LST, all participants were evaluated for a palpable pulse, distal

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Fig. 1. LST-Life saving Tourniquet™ LST: life saving tourniquet.

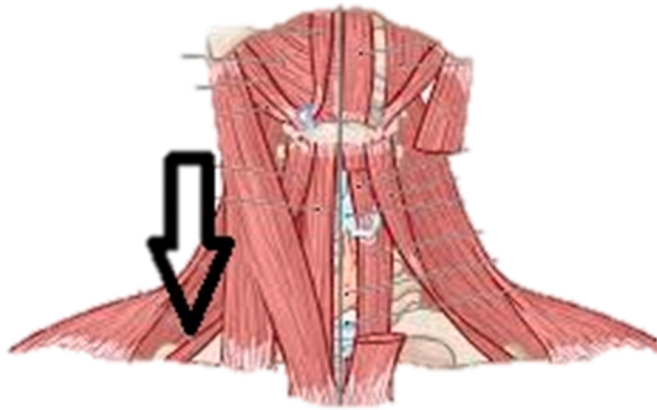


Fig. 2. Clavicular application position diagram.

pulse oximeter reading, and Doppler flow. The LST was then applied to the 2 sites. Figs. 2 and 3 show an illustration of site application. The preset application in the supraclavicular site was not using the rod for extra tension compared with the femoral site, which requires the use of the rod for creating enough localized pressure. After LST application, participants were monitored and confirmed to have: no palpable pulse, no detectable pulse oximeter reading, and no Doppler flow signal for at least 1 min. Following flow removal, return was successfully verified again using all 3 parameters.

3. Results

There are 32 participants included in the study, with 5 females and 27 males (84.3%). Average age was 25.2 years (standard deviation 9.4). All 32 participants had the LST applied to the supraclavicular point, and 31 had the LST applied to the groin area. One volunteer refused to have it applied to the groin. Table 1 summarizes the position results. Fig. 4 demonstrates axillary Doppler reading before and after LST application.

Of 32 volunteers applying the LST to the supraclavicular position, 31 (96.8%) had complete occlusion as demonstrated by all 3 parameters (pulse palpation, pulse oximeter reading, and Doppler flow). One case did not show full occlusion, but there was a weaker flow on Doppler. In 5 cases (15.6%), besides strap tightening, there was a need to strengthen the pressure using the rod. While the LST was applied in femoral position, 30 (96.7%) volunteers had complete occlusion of blood flow. The other case failed to show Doppler flow, but had no palpable pulse or pulse oximeter reading.

4. Discussion

This study aimed to assess the effectiveness of the LST as a new JT. It is simpler to apply than other existing JT and has the option to

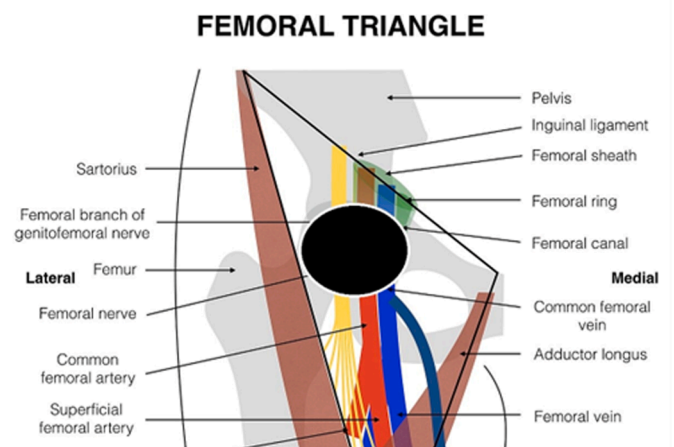


Fig. 3. Femoral application position.

Table 1

LST assessment by position and method.

Site	Method	Success (n)	Failure (n)
Shoulder/clavicle application	Pulse palpation	32	0
	Pulse oximetry	31	1
	Doppler reading	31	1
Groin/femoral application	Pulse palpation	31	0
	Pulse oximetry	31	0
	Doppler reading	30	1

LST: life saving tourniquet.

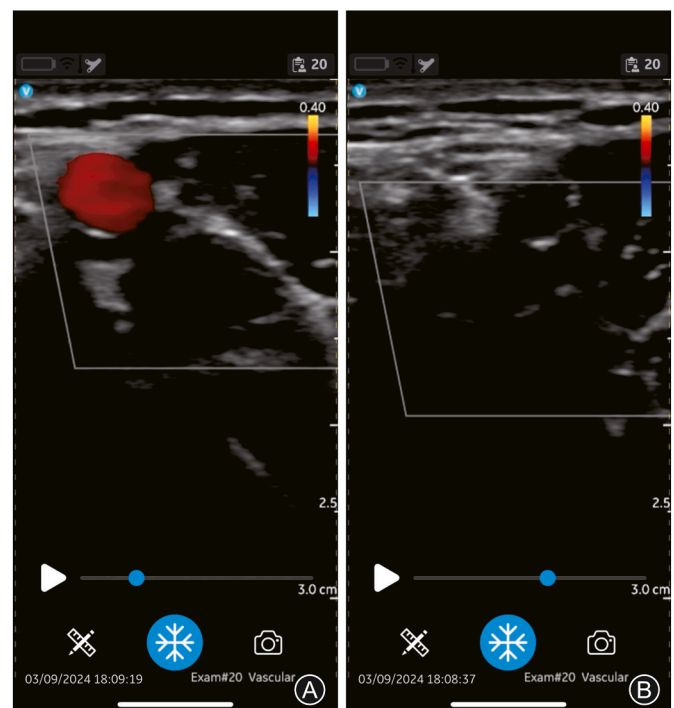


Fig. 4. Doppler reading before (A) and after (B) LST application in clavicular position.

be used as a simple tourniquet as well. It can be applied to both the supraclavicular as well as femoral positions. The LST successfully occluded blood flow after just tightening the strap in most cases in both positions. In a few cases, there was a need to use the rod,

which adds more localized pressure as per standard recommendations with usual tourniquet use.

In our study, there was 1 failure in each position (not on the same volunteer). This may be due to pain caused by the application and stopping more aggressive positioning by the handler. None of the volunteers complained of excess pain, and all had no pain or residual complaints following the application. We did not perform a pain scale evaluation as none of the participants showed signs of excess pain.

The simple concept of the LST and its use in both positions makes it a possible JT that can be easily used by field medics and even the layperson with proper instruction. It is unlikely to break or be damaged in any way and can be used as a regular tourniquet for more common injuries.

When considering the LST compared to existing JT, there is an obvious disadvantage in that it is yet unproven in the field and possibly less stable during transfer. However, a major advantage is its simplicity of application and lesser likelihood of malfunction or damage. The LST presents a novelty by being an “in between” manual and mechanical device. It requires positioning and applying pressure manually, yet once secured will not need further instrumentation.

This study is limited by its being a cohort with no comparison to other options. It was performed on healthy volunteers and was not assessed on a hemorrhagic model. The lack of a pain scale evaluation makes the pain level a subjective means of evaluation. However, in severe conditions of hemorrhage, the issue of pain may be of secondary importance. During application, actual pressure was not measured. In addition, further studies are needed to assess its success at occlusion during transport.

In conclusion, this study shows that the LST can perform successfully as a JT and can be a solution for field application in junctional hemorrhages.

Ethical statement

This study was approved by the Israeli health ministry ethics board review (202434744).

Generative AI declaration

AI was not used for this study or manuscript preparation.

Funding

This study received no funding.

Generative AI declaration

AI was not used for this study or manuscript preparation. section are missing update as per edit report.

Declaration of interest

The author is a cofounder of the researched product and serves as the companies CMO.

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